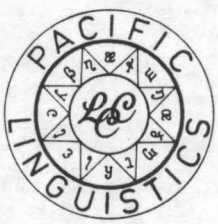
*SERIES B - No. 2*

# PHONOLOGICAL DIVERSIFICATION IN AUSTRALIAN NEW GUINEA HIGHLANDS LANGUAGES

by

S.A. Wurm

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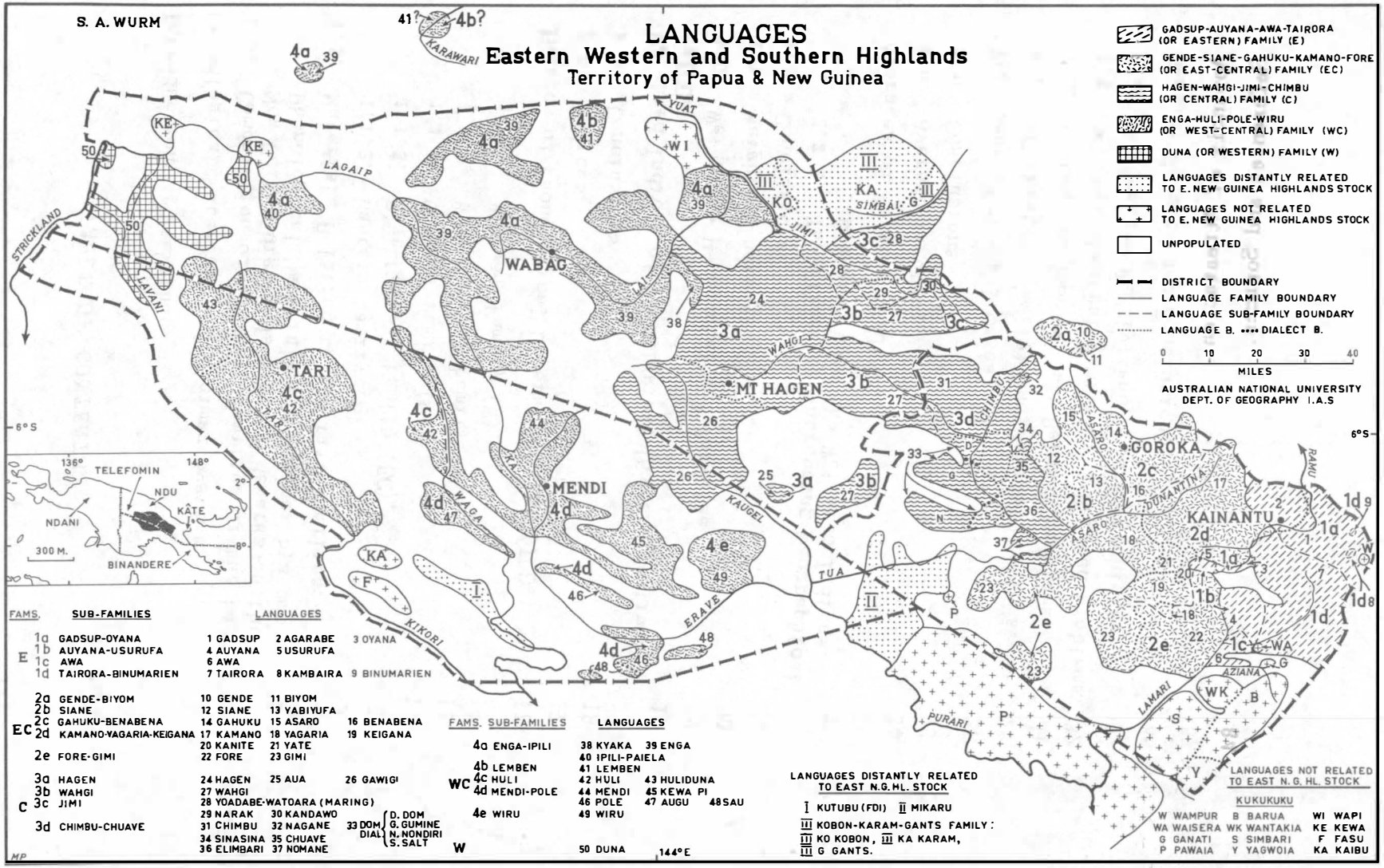


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# 0. INTRODUCTION. THE METHOD.

**0.0.** The author recently wrote an article for publication in the American Anthropologist (Wurm 1964), in which he gave an account of typological features of the languages belonging to the East New Guinea Highlands Stock which is composed of five language families (Wurm 1960, 1961a, 1961b, 1961c, 1962), and discussed the distribution of these features. In that article, mention was made of a new method suggested by C. Voegelin (Voegelin et al. 1963) for comparing typological characteristics on the phonological level, and a brief application of this method to the Families of the Stock was included in it. The present study constitutes a detailed elaboration of what has been indicated there, with a number of new ideas and methodological considerations discussed and applied.

**0.1.** Voegelin's method has as its aim the establishment of an index of synchronic phonological diversity characteristic of languages of a family, a sub-family, or any other group of interrelated languages, and consists of first constructing a maximum non-existent phonemic system showing every linear distinction found in any language of the family, sub-family, or other language group, and a minimum non-existent phonemic system embodying only those linear distinctions which are present in every language of this family, sub-family, or other group. The particular intervals between the fewest and most stops, nasals, fricatives, liquids, semi-vowels, etc. are then computed, and added up to yield what has been called the general interval characteristic of the language family or other language group in question. This general interval serves as the index of synchronic phonological diversity (IPD) in that family or group.

Note: In establishing the phoneme series which are regarded as relevant for the computation of linear distinctions in the application of the method, an interpretation of phonetic features was adhered to which, generally speaking, tends to give the basic manner of articulation the greatest influence in determining what segmental phonemes constitute a separate valid series, and which do not (see also **1.0.3.** and **1.0.4.**). This results in the recognition of plain stops, nasals, fricatives, liquids, semi-vowels and vowels as making up such series. Within the liquids, the contrast between r and l sharing the same point of articulation counts as one linear distinction and as constituting one interval.



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# 1. PHONOLOGICAL MATERIALS

**1.0.0.** Before presenting the information on the phonologies of the languages of the five Families in the Stock which is basic to our discussion, the composition of the Stock in terms of families, sub-families and languages will be given. The symbols appearing in parentheses will for the sake of brevity be frequently used in this study instead of the full names.

| *Families (F)* | *Sub-Families (SF)* | *Languages* |
|---|---|---|
| (E) Eastern | (1a) Gadsup | Gadsup, Agarabe, Oyana |
| | (1b) Auyana | Auyana, Usurufa |
| | (1c) Awa | Awa |
| | (1d) Tairora | Tairora, Kambaira, Binumarien |
| (EC) East-Central | (2a) Gende | Gende, Biyom |
| | (2b) Siane | Siane, Yabiyufa |
| | (2c) Gahuku | Gahuku, Asaro, Benabena |
| | (2d) Kamano | Kamano, Yagaria, Keigana, Kanite, Yate |
| | (2e) Fore | Fore, Gimi |
| (C) Central | (3a) Hagen | Hagen, Aua, Gawigl |
| | (3b) Wahgi | Wahgi |
| | (3c) Jimi | Maring (or Yoadabe-Watoare), Narak, Kandawo |
| | (3d) Chimbu | Chimbu, Nagane, Dom dial., Sinasina, Chuave, Elimbari, Nomane |
| (WC) West-Central | (4a) Enga | Kyaka, Enga, Ipili-Paiela (or Ipili) |
| | (4b) Lembeh | Lembeh |
| | (4c) Huli | Huli, Huliduna |
| | (4d) Mendi | Mendi, Kewapi (or Kewa Pi), Pole, Augu, Sau |
| | (4e) Wiru | Wiru |
| (W) Western | [(5a) Duna] | Duna |

**1.0.1.** In the article by Voegelin and others mentioned above, a treatment of the East-Central Family was included and, on the basis of, in part, preliminary and tentative phonemicizations, its index of phonological diversification was found to be 16 (Voegelin et al. 1963:12). Subsequent differing phonemic interpretations and the assessment of additional language materials have reduced this figure

to 14.

**1.0.2.** Some of the phonemicizations used as the basis to the present study are also preliminary and tentative, and the results arrived at here may therefore, in part, be liable to corrections.

**1.0.3.** The phonological material relevant to the subject matter of this study is confined to the segmental phonemes of individual languages. Strictly speaking, there is no need either to include in the phonological materials presented here consonant and vowel series generated by the combination of basic series with series generating components (SGC) like voicing, prenasalisation and nasalisation (e.g. the appearance of the series p t k, b d g, $^{n}$b $^{n}$d $^{n}$g), since none of these derived series exceeds the basic series in the number of its linear distinctions. As is apparent from what has been said in **0.1.**, it is this number of linear distinctions which alone is of consequence in the application of the method described. However, the omission of the derived series would give an unrealistic impression of the segmental phonemes of quite a few of the languages presented here, and it has therefore been decided to include these series in the material given below.

**1.0.4.** Palatalisation and labialisation have been treated as features giving rise to linear distinctions, and not as SGCs, mainly because palatalised and labialised consonants, in particular stops, frequently combine with other SGCs such as voicing and pre-nasalisation, to yield additional series. In addition, only very few of the languages discussed here contain palatalised and/or labialised consonants appearing in series matching the plain consonants in more than a single linear point.

**1.1.0.** It is unnecessary to present the relevant phonemic traits of all the languages of the five Families. Only those of a number of selected languages have been given; the features of those not illustrated here are, in the light of present knowledge, of such a nature that they do not affect the indices arrived at on
cussed in this study. This statement may not be correct with regard to Biyom of EC, and Lemben and Wiru of WC (see **1.1.3.** and **1.1.5.0.**).

**1.1.1.** The phonemic statements made below are based on the language materials collected by the author in New Guinea in 1958/9, and on the published and/or unpublished sources

listed under References and Sources at the end of this study.

### 1.1.2. *EASTERN FAMILY (E)*

*Gadsup (1a)*

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | d | | |
| m | n | | |
| | y | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

*Usurufa (1b)*

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | | g | |
| m | n | | |
| ?m | ?n | | |
| m: | n: | | |
| | s | | |
| w | y | | |
| ?w | ?y | | |

| | | |
|---|---|---|
| i | | u |
| e | | o |
| | a | |

*Awa (1c)*

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | | g | |
| m | n | | |
| | s | | |
| | r | | |
| w | y | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| æ | a | |

*Tairora (1d)*

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | | | |
| $^{n}$b | $^{n}$d | $^{n}$g | (1) |
| m | n | | |
| | | | h |
| | r | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

NON-EXISTENT MINIMAX SYSTEMS FOR E

MAXIMUM

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | d | g | |

MINIMUM

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | | | |

(1) $^{n}$ indicates prenasalisation with a homorganic nasal. Voicing of prenasalised stops is phonemically irrelevant, but to be consistent, the voiced stop symbols preceded by $^{n}$ have been used throughout this study to denote prenasalised stops.

| | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | r | | | | | r | |
| w | | | | y | | w | | y | |
| | | | | | | | | | |
| | | i | | | u | | | i | u |
| | | e | | ə | o | | | e | o |
| | | | a | | | | | a | |

*Gahuku Sub-Family (2c)*

*Gahuku*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| p | | t | | k | ? | | | | |
| b | | | | g | | | | | |
| m | | n | | | | | | | |
| | | s | | | h | | | | |
| | | z | | | | | | | |
| | | r | | | | | | | |
| w | | | | | | | | | |
| | | | | | | | | | |
| | i | | | | u | | | | |
| | e | | | | o | | | | |
| | | a | | | | | | | |

*Benabena*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| p | | t | | k | ? | | | | |
| b | | | | g | | | | | |
| m | | n | | | | | | | |
| f | | s | | | h | | | | |
| | | | | | | | | | |
| | | r | | | | | | | |
| | | y | | | | | | | |
| | | | | | | | | | |
| | i | | | | u | | | | |
| | e | | | | o | | | | |
| | | a | | | | | | | |

NON-EXISTENT MINIMAX SYSTEMS FOR 2c

MAXIMUM

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| p | | t | | k | ? | | | | |
| b | | | | g | | | | | |
| m | | n | | | | | | | |
| f | | s | | | h | | | | |
| | | z | | | | | | | |
| | | r | | | | | | | |
| w | | y | | | | | | | |
| | | | | | | | | | |
| | i | | | | u | | | | |
| | e | | | | o | | | | |
| | | a | | | | | | | |

MINIMUM

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| p | | t | | k | ? | | | | |
| b | | | | g | | | | | |
| m | | n | | | | | | | |
| | | s | | | h | | | | |
| | | | | | | | | | |
| | | r | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | i | | | | u | | | | |
| | e | | | | o | | | | |
| | | a | | | | | | | |

| | | |
|---|---|---|
| Stops: | 4 max. to 4 min. | = 0 interval |
| Nasals: | 2 max. to 2 min. | = 0 interval |
| Fricatives: | 3 max. to 2 min. | = 1 interval |
| Liquids: | 1 max. to 1 min. | = 0 interval |
| Semi-vowels: | 2 max. to 0 min. | = 2 intervals |
| Vowels: | 5 max. to 5 min. | = 0 interval |
| General interval | | 3 = IPD for 2c |

*Kamano Sub-Family (2d)*

*Kamano*

| | | | |
|---|---|---|---|
| p | t | k | ʔ |
| b | | g | |
| m | n | | |
| f | s | | h |
| | z | | |
| | r | | |

| | | |
|---|---|---|
| i | | u |
| e | | o |
| | a | |

*Kanite*

| | | | | |
|---|---|---|---|---|
| p | t | λ[2] | k | ʔ |
| b | | | | |
| m | n | | | |
| f | s | | | h |
| | y | | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

NON-EXISTENT MINIMAX SYSTEMS FOR 2d

MAXIMUM

| | | | | |
|---|---|---|---|---|
| p | t | k | λ | ʔ |
| b | | g | | |
| m | n | | | |
| f | s | | | h |
| | z | | | |
| | r | | | |
| | y | | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

MINIMUM

| | | | |
|---|---|---|---|
| p | t | k | ʔ |
| b | | | |
| m | n | | |
| f | s | | h |

| | | |
|---|---|---|
| i | | u |
| e | | o |
| | a | |

(2) A laterally released velar stop, mostly voiced or half-voiced.

| | | |
|---|---|---|
| Stops: | 5 max. to 4 min. | = 1 interval |
| Nasals: | 2 max. to 2 min. | = 0 interval |
| Fricatives: | 3 max. to 3 min. | = 0 interval |
| Liquids: | 1 max. to 0 min. | = 1 interval |
| Semi-vowels: | 1 max. to 0 min. | = 1 interval |
| Vowels: | 6 max. to 5 min. | = 1 interval |
| General interval | | 4 = IPD for 2d |

*Fore Sub-Family (2e)*

*Fore*

| | | | |
|---|---|---|---|
| p | t | k | ? |
| m | n | | |
| | s | | |
| w | y | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

*Gimi*

| | | |
|---|---|---|
| p | t | ? |
| b | d | |
| m | n | |
| | s | |
| | r | |
| w | y | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

NON-EXISTENT MINIMAX SYSTEMS FOR 2e

MAXIMUM

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | d | | |
| m | n | | |
| | s | | |
| | r | | |
| w | y | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

MINIMUM

| | | |
|---|---|---|
| p | t | ? |
| m | n | |
| | s | |
| w | y | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

| | | | |
|---|---|---|---|
| Stops: | 4 max. | to 3 min. | = 1 interval |
| Nasals: | 2 max. | to 2 min. | = 0 interval |
| Fricatives: | 1 max. | to 1 min. | = 0 interval |
| Liquids: | 1 max. | to 0 min. | = 1 interval |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 6 max. | to 6 min. | = 0 interval |
| General interval | | | 2 = IPD for 2e |

## NON-EXISTENT MINIMAX SYSTEMS FOR EC

| MAXIMUM | | | | | | | MINIMUM | |
|---|---|---|---|---|---|---|---|---|
| p | t | $t^y$ | λ | k | $k^w$ | ʔ | p | t |
| b | d | $d^y$ | | g | $g^w$ | | | |
| $^nb$ | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^w$ | | | |
| m | n | $n^y$ | | | | | m | n |
| f | s | | | | | h | | |
| | z | | | | | | | |
| | l | | | | | | | |
| | r | | | | | | | |
| w | | y | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| i | | | | u | | | i | u |
| e | | ə | | o | | | e | o |
| | | a | | | | | | a |

| | | | |
|---|---|---|---|
| Stops: | 7 max. | to 2 min. | = 5 intervals |
| Nasals: | 3 max. | to 2 min. | = 1 interval |
| Fricatives: | 3 max. | to 0 min. | = 3 intervals |
| Liquids: | 2 max. | to 0 min. | = 2 intervals |
| Semi-vowels: | 2 max. | to 0 min. | = 2 intervals |
| Vowels: | 6 max. | to 5 min. | = 1 interval |
| General interval | | | 14 = IPD for EC |

## 1.1.4. *CENTRAL FAMILY (C)*

### *Hagen (3a)*

| | | | | |
|---|---|---|---|---|
| p | t̪[3] | t | λ | k |
| ⁿb | ⁿd̪ | ⁿd | | ᵑg |
| m | n̪ | n | | ŋ |
| | l̪ | l | | |
| w | | y | | |

| | | |
|---|---|---|
| i | | u |
| | ɪ ʊ | |
| e | ə | o |
| | a | ɔ |

### *Wahgi (3b)*

| | | | |
|---|---|---|---|
| p | t̪ | t | k |
| ⁿb | ⁿd̪ | ⁿd | ᵑg |
| m | n̪ | n | ŋ |
| | l̪ | l | |
| w | | y | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

### *Narak (3c)*

| | | | |
|---|---|---|---|
| p | t̪ | t | k |
| b | d̪ | d | g |
| ⁿb | ⁿd̪ | ⁿd | ᵑg |
| m | n̪ | n | ŋ |
| | | s | |
| | l̪ | l | |
| w | | y | |

| | | |
|---|---|---|
| i | | u |
| | ʊ | |
| e | ə | o |
| | a | ɔ |

### *Chimbu Sub-Family (3d)*

#### *Chimbu*

| | | | |
|---|---|---|---|
| p | t | λ | k |
| ⁿb | ⁿd | | ᵑg |
| m | n | | |
| | s | | |

#### *Sinasina*

| | | |
|---|---|---|
| p | t | k |
| b | d | g |
| m | n | ŋ |
| | s | |

---

(3) The symbols marked with ̪ indicate usually slightly palatalised or affricated dental stops, or slightly palatalised dental nasals and laterals. The corresponding symbols without ̪ denote alveolar consonants.

| | | |

NON-EXISTENT MINIMAX SYSTEMS FOR C

| MAXIMUM | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|
| p | t | t | λ | k | p | t | k |
| b | d | d | | g | | | |
| $^{n}$b | $^{n}$d | $^{n}$d | | $^{n}$g | | | |
| m | n | n | | ŋ | m | n | |
| | | s | | | | | |
| | l | l | | | | l | |
| | | r | | | | | |
| w | | y | | | w | y | |
| i | | | u | | i | | u |
| | ɪ | ʊ | | | | | |
| e | ə | | o | | e | | o |
| | a | | ɔ | | | a | |

| | | |
|---|---|---|
| Stops: | 5 max. to 3 min. | = 2 intervals |
| Nasals: | 4 max. to 2 min. | = 2 intervals |
| Fricatives: | 1 max. to 0 min. | = 1 interval |
| Liquids: | 3 max. to 1 min. | = 2 intervals |
| Semi-vowels: | 2 max. to 2 min. | = 0 interval |
| Vowels: | 9 max. to 5 min. | = 4 intervals |
| General interval | | 11 = IPD for C |

### 1.1.5. *WEST-CENTRAL FAMILY (WC)*

**1.1.5.0.** The author's information on the phonologies of Lemben constituting SF 4b, and of Wiru constituting SF 4e, is insufficient, or not reliable enough, to justify their inclusion here. Both languages have been disregarded for the purpose of this study, and the IPD arrived at for WC is not intended to cover them.

**1.1.5.1.0.** The phonologies of the languages belonging to the Enga Sub-Family (4a), and of Mendi of SF 4d, show considerable complexity on the consonant level when compared with other languages of the Stock. (This statement also holds for Duna constituting the Western Family.) This phenomenon is responsible for the high IPD for WC of 17, and also for the IPDs yielded by non-existent minimax systems for pairs

of the Sub-Families of WC, and for pairs of the Families in which one of the two Families is WC (see **2.0.1.**). (The same phenomenon is one of the factors producing the high IPDs yielded for pairs of the Families consisting of W + another Family.)

**1.1.5.1.1.** The complexities in the phonological charts of these languages could largely be avoided through following alternative phonemicizations by cluster solution, but this would lead to complexities on the syllable level which would exceed anything encountered in the phonologies of the other languages of the Stock. Similarities brought about between the phonemic charts for the languages of SF 4a and Mendi (as well as Duna), and for other languages of the Stock as a result of phonemicizing the former languages by cluster solution are artificial and unrealistic, because they result from replacing one type of contrast discernible from the charts by another one which is not apparent in the skeleton charts in this study.

**1.1.5.1.2.** To demonstrate the difference between the two phonemic charts of Enga, one arrived at by complex consonant, and the other by cluster solution, both have been given below, but the latter has not been used in establishing the IPD for WC.

**1.1.5.1.3.** The phonemic complexities referred to here as characteristic of the languages of SF 4a, Mendi, and Duna, constitute one of the regional features within the Stock. There are quite a number of such regional features in the Stock, both on the phonological and morphological levels (Wurm 1964).

*Enga (4a)*

*Complex Consonant Solution*

| p | $p^y$ | $p^w$ | t | $t^y$ | k | $k^y$ | $k^w$ |
|---|---|---|---|---|---|---|---|
| $^nb$ | | $^nb^w$ | $^nd$ | $^nd^y$ | $^ng$ | $^ng^y$ | $^ng^w$ |
| m | | $m^w$ | n | $n^y$ | ŋ | | |
| | | | s | $s^y$ | | | |
| | | | l | $l^y$ | | | |
| | | | r | $r^y$ | | | |
| w | | | | y | | | |

*Cluster Solution* [4]

| p | t | k |
|---|---|---|
| ($^nb$ | $^nd$ | $^ng$) |
| m | n | ŋ |
| | s | |
| | l | |
| | r | |
| w | y | |

[4] As can be seen from this chart, it has been possible to reduce the number of vowel phonemes by an alternative phonemicization.

i u
e o
ʌ
a

i u
e o
a

*Huli (4c)*

| | | | |
|---|---|---|---|
| p | t | k | |
| b | d | g | |
| m | n | | h |
| | l | | |
| | r | | |
| w | y | | |

i u
e o
a

*Mendi Sub-Family (4d)*

*Mendi*

| | | | | |
|---|---|---|---|---|
| p̪ | $p^w$ | t | k | $k^w$ |
| $^nb$ | | $^nd$ | $^ng$ | |
| m̪ | $m^w$ | n | $n^y$ | |
| | | s | | |
| | | l | $l^y$ | |
| | | r | | |
| w | | | y | |

i u
e ə o
æ a

*Kewapi*

| | | | |
|---|---|---|---|
| p | t | $t^y$ | k |
| | | | g |
| $^nb$ | $^nd$ | | $^ng$ |
| m | n | $n^y$ | |
| | s | | |
| | l | | |
| | r | | |
| w | | y | |

i u
e o
a

*Pole*

| | | | |
|---|---|---|---|
| p̪ | t | | k |
| b | | | g |
| $^nb$ | $^nd$ | | $^ng$ |
| m̪ | n | $n^y$ | |
| | s | | |

*Sau*

| | | | |
|---|---|---|---|
| p | t | | k |
| b | | | g |
| $^nb$ | $^nd$ | | $^ng$ |
| m | n | $n^y$ | |
| | z | | h |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | l | | | | | | | | l | | |
| | | | | | | | | | | | | r | | |
| w | | | | | y | | | | w | | | | y | |
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| | | e | | | | o | | | | e | ə | | | o |
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| | | | | ã | | | | | | | | ã | | |

NON-EXISTENT MINIMAX SYSTEMS FOR 4d

| MAXIMUM | | | | | | | | | | | | MINIMUM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p | | $p^w$ | t | | $t^y$ | k | | $k^w$ | | | | p | | t | | | k |
| b | | | | | | g | | | | | | | | | | | |
| $^nb$ | | | $^nd$ | | | $^ng$ | | | | | | $^nb$ | | $^nd$ | | | $^ng$ |
| m | | $m^w$ | n | | $n^y$ | | | | | | | m | | n | | $n^y$ | |
| | | | s | | | | | | h | | | | | | | | |
| | | | z | | | | | | | | | | | | | | |
| | | | l | | $l^y$ | | | | | | | | | l | | | |
| | | | r | | | | | | | | | | | | | | |
| w | | | | | y | | | | | | | w | | | | y | |
| | | | | | | | | | | | | | | | | | |
| | | i | | | | u | | | | | | | i | | | | u |
| | | e | ə | | | o | | | | | | | e | | | | o |
| | | æ | a | | | | | | | | | | | a | | | |
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| | | ẽ | ə̃ | | | õ | | | | | | | | | | | |
| | | | ã | | | | | | | | | | | | | | |

| | | |
|---|---|---|
| Stops: | 6 max. to 3 min. | = 3 intervals |
| Nasals: | 4 max. to 3 min. | = 1 interval |
| Fricatives: | 2 max. to 0 min. | = 2 intervals |
| Liquids: | 3 max. to 1 min. | = 2 intervals |
| Semi-vowels: | 2 max. to 2 min. | = 0 interval |
| Vowels: | 7 max. to 5 min. | = 2 intervals |
| General interval | | 10 = IPD for 4d |

## NON-EXISTENT MINIMAX SYSTEMS FOR WC

| MAXIMUM | | | | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^y$ | $p^w$ | t | $t^y$ | k | $k^y$ | $k^w$ | | p | t | k |
| b | | | d | | g | | | | | | |
| $^nb$ | | $^nb^w$ | $^nd$ | $^nd^y$ | $^ng$ | $^ng^y$ | $^ng^w$ | | | | |
| m | | $m^w$ | n | $n^y$ | ŋ | | | | m | n | |
| | | | s | $s^y$ | | | | h | | | |
| | | | z | | | | | | | | |
| | | | l | $l^y$ | | | | | | l | |
| | | | r | $r^y$ | | | | | | | |
| w | | | | y | | | | | w | y | |

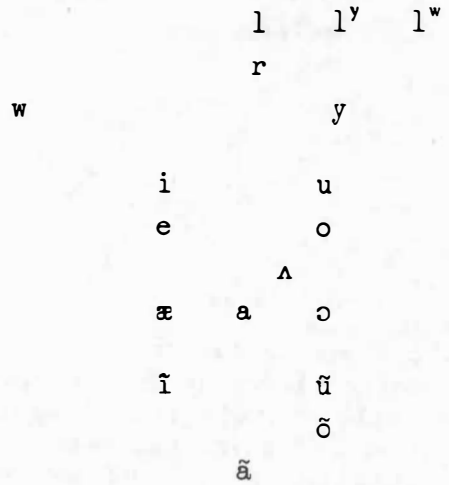
| MAXIMUM | | | MINIMUM | |
|---|---|---|---|---|
| i | | u | i | u |
| e | ə | o | e | o |
| | ʌ | | | |
| æ | a | | a | |
| ĩ | | ũ | | |
| ẽ | ə̃ | õ | | |
| | ã | | | |

| | | | |
|---|---|---|---|
| Stops: | 8 max. | to 3 min. | = 5 intervals |
| Nasals: | 5 max. | to 2 min. | = 3 intervals |
| Fricatives: | 3 max. | to 0 min. | = 3 intervals |
| Liquids: | 4 max. | to 1 min. | = 3 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 8 max. | to 5 min. | = 3 intervals |
| General interval | | | 17 = IPD for WC |

### 1.1.6. *WESTERN FAMILY (W)*

*Duna [(5a)]*

| | | | | | | |
|---|---|---|---|---|---|---|
| p | $p^w$ | t͡ | t | $t^y$ | k | $k^w$ |
| b | $b^w$ | | | $d^y$ | g | $g^w$ |
| $^nb$ | | | $^nd$ | $^nd^y$ | $^ng$ | $^ng^w$ |
| m | | | n | $n^y$ | $n^w$ | g |
| | | | s | | | |




No IPD can be computed for W seeing that it consists only of one language.

## 2. INDICES OF PHONOLOGICAL DIVERSIFICATION (IPDs)

**2.0.0.** The following IPDs have been yielded by the procedures described in the foregoing: E 7, EC 14 (2c: 3, 2d: 4, 2e: 2), C 11 (3d: 4), WC 17 (4d: 10). Before starting to draw conclusions, it is necessary to compute also the figures yielded by minimax systems for pairs of the Sub-Families within the Families, and for pairs of Families.

**2.0.1.** So as not to overload the text of this study with minimax systems and computations, these will from this point on be given in an appendix of attestation, and only the resulting IPDs included in the text together with a reference to the appendix (in the form Att. + a number).

*Sub-Families:*

| E | EC | C | WC [5] |
|---|---|---|---|
| 1a | 2a | 3a | 4a |
| 4 1b | 7 2b | 4 3b | 14 4c |
| 4 2 1c | 11 5 2c | 3 3 3c | 16 10 4d |
| 3 4 5 1d | 13 7 6 2d | 9 10 10 3d | |
| | 8 5 7 8 2e | | |
| (Att.1-6) | (Att.7-16) | (Att.17-22) | (Att.23-25) |

[5] See 1.1.5.0. for the omission of 4b and 4e.

*Families:*

| | | | | |
|---|---|---|---|---|
| E | | | | |
| 15 | EC | | | |
| 17 | 21 | C | | |
| 21 | 24 | 24 | WC | |
| 20 | 23 | 21 | 21 | W |

(Att. 26-35)

**2.1.0.** The figures given above appear to be indicative of a number of facts which can be viewed as follows in the light of the distribution of other typological features in the languages of the Stock (much of which has been described in Wurm 1964), and in part also in that of the results of lexical comparisons (Wurm 196la):

**2.1.1.** E and C are more homogenous on the phonological level than are EC and especially WC. Generally speaking, this tallies reasonably well with the picture given by other typological features in these Families. With regard to the internal composition of the Families, it appears that, except for 3d, the Sub-Families in E and C are less different from each other phonologically than in EC and especially WC. This is again paralleled to a considerable extent by the evidence obtained from the study of other typological characteristics. In E, 1d appears to be somewhat aberrant, but only very little so - other typological features give a somewhat similar picture, but on the lexical level 1d differs greatly from the other three Sub-Families of E. In EC, 2a seems to be phonologically highly aberrant, and 2e less so - both these phenomena are well confirmed by other typological and to a reasonable extent, also by lexical evidence. In C, 3d appears to differ markedly from the other Sub-Families on the phonological level. While there is a certain amount of typological difference between 3d and the other three Sub-Families of C, it is not comparable to the difference suggested by the IPDs, and is not supported by the lexical evidence. 3a is much more aberrant typologically and lexically than 3d. In WC, the comparison of 4a with the other two Sub-Families considered for the purpose of this study yields higher IPDs than the comparison of the latter two Sub-Families with each other. This in itself is to quite some extent in conformity with other typological findings, less so with lexical ones. However, the presence of Mendi in 4d, with its phonology which is not too unlike that of the languages of 4a, gives rise to the expectation that the IPD for 4a-4d may be lower than that

for 4a-4c. In fact, though, the opposite is the case.

**2.1.2.** From the comparisons on the family level, a relatively low IPD for E from EC becomes apparent - which is the same as shown by other typological features to an even greater extent, and by lexical results to a lesser extent. The IPD for C-E is remarkably low relative to C-EC and C-WC which contradicts the findings on the typological level in general, and the IPDs separating WC and W from the other Families and from each other are quite high which again is not well supported by other typological evidence which shows the presence of some measure of typological agreement between EC and WC. It is true that W is typologically, and lexically, very different from the other four Families, but of all of them, it shows most typological, and lexical, similarity with WC which is not confirmed by the IPD for W-WC. E, EC and W show some tendency towards an increase in their IPDs as geographical distance increases which seems plausible, whereas for C, and to some extent for WC, the reverse holds true. This is contrary to expectations and in itself is inconsistent: in the case of EC-WC where the presence of some typological agreement on other levels would make a lower IPD seem reasonable, it is particularly high.

## 3. WEIGHTED INDICES OF PHONOLOGICAL DIVERSIFICATION (wIPDs)

**3.0.0.** The above discussion shows a prevalence of parallelism between the picture given by the IPDs, and findings on other typological levels, but there are a few marked deviations. While the existence of such deviations is perfectly possible, it may be a matter for consideration whether the figures used are the best available, and whether or not they could be improved.

**3.0.1.** One drawback of the figures appears to be that they are based on numbers of languages varying from one to fourteen on each side of a pair in a comparison. The first step towards obtaining better figures may therefore seem to be an attempt to weight the figures in such a way that the number of languages underlying each one of them constitutes a common denominator.

**3.0.2.** The number of languages in the Stock is fifty. However, three have been disregarded for the purpose of this study (see **1.1.3.** and **1.1.5.0.**), so that their number is effectively reduced to forty-seven. This gives an average of 9.4 languages per family. To arrive at a weighted IPD

(wIPD) for a family, the formula

$$\frac{\text{IPD}}{\text{number of languages}} \times 9.4$$

seems suitable. A wIPD resulting from the comparison of two families would be yielded by the formulae

$$\frac{\text{IPD}}{(\text{number of languages}) \div 2} \times 9.4$$

or

$$\frac{\text{IPD}}{\text{number of languages}} \times (9.4 \times 2).$$

The number of sub-families in the Stock is nineteen, but two of them, 4b and 4e, are being disregarded (see **1.1.5.0.**) which makes their effective number seventeen. (2a is included in this figure because only one language in that Sub-Family has been disregarded, not the entire Sub-Family, see **1.1.3.**). The average number of languages per sub-family is 47 ÷ 17 = 2.76, which makes the formula for arriving at the wIPD for a sub-family

$$\frac{\text{IPD}}{\text{number of languages}} \times 2.76,$$

and for the wIPD resulting from the comparison of two sub-families

$$\frac{\text{IPD}}{(\text{number of languages}) \div 2} \times 2.76$$

or

$$\frac{\text{IPD}}{\text{number of languages}} \times (2.76 \times 2).$$

**3.1.** The application of the formulae described above to the figures given in **2.0.0.** and **2.0.1.** yields the following wIPDs (worked out to two decimals): E 7.33, EC 10.12 (2c: 2.76, 2d: 2.21, 2e: 2.76), C 7.43 (3d: 1.58), WC 15.98 (4d 5.52).

*Sub-Families:*

| E | | | | EC | | | | |
|---|---|---|---|---|---|---|---|---|
| 1a | | | | 2a | | | | |
| 4.42 | 1b | | | 12.89 | 2b | | | |
| 5.34 | 3.55 | 1c | | 15.18 | 5.52 | 2c | | |
| 2.76 | 4.42 | 6.90 | 1d | 11.98 | 5.52 | 4.15 | 2d | |
| | | | | 14.74 | 6.90 | 7.73 | 6.32 | 2e |

| | | | | C | | | | WC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3a | | | | | | | 4a | | | | |
| 5.52 | 3b | | | | | | 15.46 | 4c | | | |
| 2.76 | 4.14 | 3c | | | | | 11.04 | 7.89 | 4d | | |
| 4.97 | 6.90 | 5.52 | 3d | | | | | | | | |

*Families:*

| E | | | | |
|---|---|---|---|---|
| 12.78 | EC | | | |
| 13.91 | 14.57 | C | | |
| 20.77 | 19.62 | 18.80 | WC | |
| 37.60 | 30.89 | 26.32 | 35.91 | W |

These figures call for the following comments:

**3.2.0.** wIPDs for the individual Families and Sub-Families:

The wIPDs give much the same picture of the measure of phonological homogeneity of the Families as the IPDs, except that the wIPD for E shows almost the same level of homogeneity as that indicated by the wIPD for C, whereas the two IPDs differ considerably. The wIPDs for the Sub-Families seem quite acceptable, and the levelling effect of calculating wIPDs becomes quite apparent. The rate of phonological diversification in the three Sub-Families 2c, 2d and 2e is in fact of a rather similar order when considering that the differing concrete rates of diversity are manifested by a differing number of languages. The wIPD for 3d may look a little low at first sight when thinking of the level of concrete phonological diversity in 3d. However, when the very large number of seven languages in 3d is borne in mind, the low wIPD appears perfectly understandable. The high wIPD for 4d seems plausible in spite of the large number of five languages in 4d when the phonological differences between Mendi and the other languages of 4d are taken into consideration.

**3.2.1.** wIPDs for pairs of Sub-Families:

Again, the wIPDs give a picture not unlike that provided by the IPDs of the Sub-Families in E and C being less different from each other phonologically than in EC and WC. However, when the wIPDs for pairs of the Sub-Families in EC excluding 2a are taken into consideration, it seems that 2b, 2c, 2d, and even 2e, are not much more different from each other phonologically than the Sub-Families of E and C.

In E, the somewhat aberrant phonological character of 1d suggested by the IPDs (see **2.1.1.**) is not borne out by the wIPDs, in fact, the wIPD of 2.76 for 1a-1d is lower than that for 1a-1b. This may seem strange at first sight in the light of other typological evidence which points in the opposite direction, but it may be taken into account that considerable typological agreement between languages of 1a and 1b is largely confined to Oyana on the 1a side, whereas Gadsup and Agarabe are typologically more like 1d in some respects, which makes the low wIPD seem more acceptable, in spite of the presence of some other somewhat aberrant typological characteristics of 1d. At the same time, the extent of areal contact between 1d and the other Sub-Families may well be a contributing factor to the low wIPD for 1a-1d (see **3.2.2.1.**). In EC, the great phonological difference between 2a and the other Sub-Families is even better demonstrated by the wIPDs than by the IPDs, and the much lesser phonological aberration of 2e from 2b, 2c and 2d is also made evident much more clearly by the wIPDs. In C the apparent great phonological difference of 3d from the other Sub-Families indicated by the IPDs is shown by the wIPDs to be only very slight, which is much more satisfactory in the light of other typological evidence. The relatively low wIPD of 4.97 for 3a-3d is surprising when taking into account that 3a is the typologically and lexically most aberrant Sub-Family in C, and 3a and 3d are located at opposite geographic extremes of C. In WC, the wIPDs for 4a-4c and 4a-4d are, like the IPDs, higher than that for 4c-4d, and the difference is even greater than with the IPDs. At the same time, the wIPD for 4a-4d is lower than that for 4a-4c which reverses the undesirable picture given by the IPDs and comes up to expectations.

**3.2.2.0.** The wIPDs for pairs of the Families give largely the same impression as the IPDs. The wIPD for C-E is just as unsatisfactorily low in comparison to those for C-EC and C-WC as the IPD, the wIPD for EC-WC is even higher relative to the one for C-WC than is the case with the IPD, and the wIPD for WC-W is extremely high - much higher even than the IPDs for W + another Family may suggest. The only marked improvement of the wIPDs over the IPDs is in the matter of an increase in the figures with increasing geographical distance: there is a clear tendency towards this with the wIPDs, and it is broken only by the over-high wIPDs for EC-C and WC-W.

**3.2.2.1.** Looking at the effect of increasing geographical distance upon the wIPDs for pairs of the Sub-Families, the

following becomes evident: in E, the location of the languages in relation to each other allows this factor to be taken fully into account only with 1a-1b relative to 1a-1c: the wIPD for the latter is in fact higher than that for the former which may, of course, be not solely attributable to increased geographical distance. The situation of 1d is peculiar: it has an extensive border with 1a, a much shorter one at a corner of its area with 1b, and is only approaching, but not directly bordering on, 1c in one small extreme corner section of its territory. This parallels its wIPDs from these three Sub-Families: the more limited the areal contact of 1d with any particular one of them, the higher the wIPD for 1d + this particular Sub-Family. This phenomenon can be regarded as a modification of the principle of increased geographical distance paralleling increasing wIPDs. It is also observable in the wIPDs for other pairs of Sub-Families in E: the wIPD for 1a-1b is higher than that for 1a-1d: the extent of areal contact between 1a and 1d exceeds the one between 1a and 1b by far. The wIPD for 1b-1c is lower than that for 1a-1b: again, the areal contact between 1b and 1c is more extensive than that between 1a and 1b. It seems that, contrary to what can be observed in the other Families, the factor of the extent of areal contiguity between the Sub-Families is of primary importance for the size of wIPDs for pairs of Sub-Families in E, with other typological, and lexical, factors playing only a secondary part. In EC, the increase in geographical distance is well reflected in increasing wIPDs in the cases of 2b, 2c and 2d. With 2e, the tendency is present, but the line of increase is broken by the wIPD for 2b-2e which is lower than that for 2c-2e. With 2a, some of the tendency is noticeable, but it is not consistent. In particular, the wIPD for 2a-2d is lower than those for 2a-2b, 2a-2c and 2a-2e. In C, the factor of increasing geographical distance can only be taken into consideration with relation to 3a-3d in view of the location of the languages. However, while the IPD for 3a-3d is very high, the wIPD is relatively low, lower than those for 3a-3b and 3b-3d, though higher than that for 3a-3c. This is contrary to expectations, in particular if it is borne in mind that 3a is the typologically and lexically most aberrant Sub-Family of C (see **3.2.1.**). In WC, the factor of increasing geographical distance cannot be assessed with the Sub-Families taken into consideration in this study. In short, the augmenting effect of increasing geographical distance upon wIPDs is just as noticeable with those for pairs of the Sub-Families as with those for pairs of the Families - the only deviations from this are the wIPDs for 2a-2d, 2b-2e and 3a-3d.

## 4. AVERAGES OF wIPDs

**4.0.** At this stage, the calculation of averages of the wIPDs may be useful. In this, the average values for the wIPDs for pairs consisting of one Sub-Family + each of the other Sub-Families of the same Family are computed, and they indicate the average rate of phonological diversification of that Sub-Family from the other Sub-Families. The same procedure is repeated on the family level, and overall averages (o.a.) of the average wIPDs for each Family and the Stock are worked out:

*Sub-Families:*

E: 1a 4.17, 1b 4.13, 1c 5.26, 1d 4.96 } o.a. 4.56

EC: 2a 13.70, 2b 7.71, 2c 8.14, 2d 6.99, 2e 8.92 } o.a. 9.09

disregarding 2a: 2b 5.98, 2c 5.89, 2d 5.33, 2e 6.85 } o.a. 6.01

disregarding 2a and 2e: 2b 5.52, 2c 4.83, 2d 4.83 } o.a. 5.06

C: 3a 4.42, 3b 5.52, 3c 4.14, 3d 5.80 } o.a. 4.97

disregarding 3d: 3a 4.14, 3b 4.83, 3c 3.45 } o.a. 4.14

WC: 4a 13.60, 4c 11.68, 4d 9.61 } o.a. 11.70

*Families:*

E 21.26, EC 19.46, C 18.40, WC 23.78, W 32.68 } o.a. 23.12

**4.1.0.** These figures serve as good illustrations for much of what has been commented on above in **3.2.**, and allow a few additional conclusions to be drawn:

**4.1.1.** The difference between the Sub-Families of EC appears to be considerable relative to that between those of E and C. However, if the disturbing influence of the highly aberrant 2a is disregarded, as it has been done in **3.2.1.** for the wIPDs, it is evident that the Sub-Families in EC exhibit only relatively little more phonological diversification than those of E and EC. The exclusion of the somewhat aberrant 2e demonstrates that the phonological diversity between 2b, 2c and 2d is only slightly greater than that existing between the Sub-Families of E and EC. The calculation of the averages for 2b-2c-2d only, shows the somewhat aberrant phonological nature of 2b relative to 2c and 2d, and the identical phonological position of 2c and 2d within this restricted group. In C, disregarding 3d cuts down the o.a. for the remaining Sub-Families to a figure below the o.a. for E. The phonological diversity of the Sub-Families of WC is more than twice as great as that of those of E and C.

**4.1.2.** In E, 1b seems to be phonologically central which tallies quite well with other typological, and lexical, evidence. 1a is very close to it phonologically though geographically removed from it in its bulk, but it has to be borne in mind that Oyana of 1a is adjacent to Usurufa of 1b, and in some of its features shows more agreement with the languages of 1b than do the other languages of 1a. The average figures for the four Sub-Families demonstrate the influence of their geographical location relative to each other and of the resulting areal contact between them, which has been found to be of great importance in E (see **3.2.2.1.** for the wIPDs for pairs of Sub-Families) but they also bear evidence of some modification of this influence through, as it were, pressure from other typological factors which seemed rather unimportant when considering the wIPDs themselves (see **3.2.2.1.**): 1b is central, and 1a and 1d have areal contact with it, but 1d is the typologically (and lexically) most aberrant of the three, and in consequence its average figure is higher than those for the other two Sub-Families. 1a, 1b and 1d constitute, geographically speaking, the bulk of E. 1c is located in an extreme corner of the area occupied by the Family, has some areal contact only with 1b, is removed from the other Sub-Families, and is typologically somewhat aberrant: as may be expected, its average figure is the highest in E, though it is not very

much higher than that for 1d.

**4.1.3.** In EC, 2d appears to be phonologically central which seems plausible when taking into account other typological, and also lexical, evidence, and the geographical location of 2d within the area occupied by EC. There is a steady increase in the average figures as one moves towards the fringes of the EC territory, except for a break caused by the comparatively low average figure for 2b, which is lower than that for 2c. However, if 2a is disregarded in the calculation of the average figures, there is no break in the continuity of the increase, and the average figure for 2b is higher than that for 2c. The highly aberrant phonological character of 2a, and the less aberrant one of 2e, are made very clear through the average figures for them.

**4.1.4.** In C, 3c seems to be phonologically central which comes up to expectations when considering other typological, and also lexical, evidence. Its geographical location is also gravitating towards the hub of the Family. The increase in the average figures as one moves towards the borders of the Family is broken by that for 3a which is almost as low as that for 3c, and is at variance with other typological, and lexical, evidence. As has already been insinuated (see **3.2.1.** and **3.2.2.1.**), 3a constitutes an instance in which the findings on the level of phonological diversification contradict other typological, and lexical, evidence, and also do not correspond to what one might expect on the basis of the geographical location of 3a within C. The relatively high average figure for 3b is somewhat surprising, but seeing that it consists of a single language only, even its comparatively minor phonological differences from the other Sub-Families count rather heavily in the calculation of the wIPDs underlying the average figure for it. In other words, its phonological diversity from the other Sub-Families is in fact greater than a cursory look at its phonological character may reveal. The relative insignificance of the phonological aberration of 3d (see **3.2.1.**) is confirmed by the average figure for it. If 3d is disregarded in the calculation of the average figures, the phonologically central position of 3c becomes more pronounced: the average figure for it drops by 0.69, and so does that for 3b, but that for 3a drops only by 0.28.

**4.1.5.** In WC, 4d appears to be phonologically central which is to quite some extent paralleled by other typological, though not so much by lexical, evidence. 4c is much closer to 4d phonologically than 4a which is also borne out to a

considerable degree by the findings on other typological levels, though in a few typological features, and also on the lexical side, 4c shows greater agreement with 4a than with 4d.

**4.1.6.** On the Family level, the average figures demonstrate that C is apparently phonologically central, which agrees with its central geographical position, and some of the other typological, as well as the lexical, evidence points in the same direction. There is a gradual increase in the average figures as one moves from C towards the eastern and western limits of the Stock, which demonstrates the augmenting effect of increasing geographical distance upon the wIPDs very well, much better than the listing of the wIPDs themselves (see **3.2.2.0.**). The effect of the wIPD for C-EC which is unsatisfactorily high relative to C-E has been cancelled out in the average figures, and so has that of the over-high wIPD for WC-W. As seems to be the case with the factor of areal contiguity between the Sub-Families in E in connection with wIPDs for pairs of Sub-Families, the factor of increased geographical distance appears to have an overriding augmenting effect upon the size of the average figures on the Family level, with other typological (and lexical) factors playing only a minor part: on the basis of other typological, and lexical findings, the average figures for E and EC may be expected to be more similar to each other than those for EC and C, but the opposite is the case.

## 5. TREATMENT OF SPECIAL CASES

**5.0.** In the discussion presented so far, special treatment of the figure material made available through calculations based on phonological minimax systems has brought the figures more and more in line with what may have been expected when bearing in mind the evidence provided by the comparison of other typological features. However, there are still instances in which figures, that is, wIPDs and figures based on them, are unsatisfactory in the light of such other typological, and perhaps lexical, findings, and in which there appears to be a possibility for improving on them. Attempts at doing so will be undertaken in what follows. Instead of dealing with the figures under headings, such as figures for the individual Families and Sub-Families, pairs of sub-families, pairs of families, average figures, etc. as has been done up to this point of this study, it appears to be more appropriate to discuss them in sets of interconnected problems.

**5.1.0.** EC and related problems:

**5.1.1.** The comparatively high wIPD for EC which is paralleled to a considerable extent by other typological findings, may be due to the influence of the highly aberrant 2a which is a disturbing factor on phonological and other typological, as well as lexical, levels. Disregarding 2a in the calculation of the IPD for EC (Att.36) yields 9 (as opposed to the IPD for EC of 14!) which in turn yields a wIPD of 7.05 (as opposed to the wIPD for EC of 10.12). This is lower than the wIPDs for both E and C.

**5.1.2.0.** The IPD for E-(EC without 2a) (Att.37) is 12 which yields a wIPD of 10.72, while the IPD for (EC without 2a)-C (Att.38) is 18, and the wIPD 13.01, which reverses the unsatisfactory picture given by the wIPD for E-EC, and by that for E-C relative to that for EC-C. If EC is replaced by EC without 2a which is marked as (EC), the wIPDs for pairs of Families are:

| | | | | |
|---|---|---|---|---|
| E | | | | |
| 9.87 | (EC) | | | |
| 13.91 | 13.01 | C | | |
| 20.77 | 20.49 | 18.8 | WC | |
| 37.60 | 31.78 | 26.32 | 35.91 | W |

(Att. 39-40 for (EC)-WC and (EC)-W).

**5.1.2.1.** These figures disclose the similarity of E and (EC) on the phonological level which is closely paralleled by other typological, and to a lesser extent by lexical, evidence. The wIPD for E-C is greater than that for (EC)-C which is what may be expected, though the wIPDs for E-C and EC-C show the opposite. The wIPD for (EC)-WC is very high, even higher than that for EC-WC, which is unsatisfactory.

**5.1.3.0.** When calculating average figures for the wIPDs for pairs of the Families, replacing EC by (EC), the resulting figures show much the same picture as those arrived at on the basis of EC which confirms the assumption of the overriding effect of geographical distance upon the size of the average figures on the family level (see **4.1.6.**):

| | | |
|---|---|---|
| E | 20.54 | |
| (EC) | 18.79 | |
| C | 18.01 | o.a. 22.85 |
| WC | 23.99 | |
| W | 32.90 | |

**5.1.3.1.** It is very interesting to see the average figures for the wIPDs for pairs of the Families arrived at on the basis of (EC), when W is disregarded:

| | | |
|---|---|---|
| E | 14.85 | o.a. 16.14 |
| (EC) | 14.46 | |
| C | 15.24 | |
| WC | 20.02 | |

**5.1.3.2.** In this calculation, the effect of the extreme geographical distance between W and E is not present which produces a sharp drop in the average figure for E. As a result of this, the average figures for E and (EC) are more similar to each other (the difference between them is 0.39) than those for (EC) and C (their difference is 0.78). At the same time, the phonological centre has shifted to (EC). The great phonological difference between W and the other four Families manifests itself in the considerable reduction in the size of the average figures for the individual Families, and of the o.a.

**5.1.4.0.** 2a shows a number of affinities to C on the typological level, and it may be of interest to investigate if and how far the great phonological diversification of 2a from the other Sub-Families of EC as expressed by the high wIPDs for 2a + one of these other Sub-Families may be due to a high phonological affinity of 2a to C.

**5.1.4.1.** The procedure for this is to calculate the wIPD for C + 2a as if 2a, i.e. Gende, belonged to C, and to assess the effect of the inclusion of 2a with C upon the wIPD for C. The IPD for C + 2a (Att. 41) is 14 (3 more than the IPD for C) yielding a wIPD of 8.79 which is 1.46 higher than the wIPD for C. By way of contrast, the exclusion of 2a from EC resulted in a drop of the IPD for EC by 5, and of the wIPD by 3.07 which seems to suggest that 2a has higher phonological affinity to C than to EC, though its affinity to C is still of a low order, because if C and 2a were phonologically close, it would not materially increase its IPD, and one would not expect more than perhaps a slight increase, if any at all, in its wIPD because of the addition of one language without an accompanying considerable intensification in the phonological diversity of C. For instance, if the IPD of C + one extra language was increased from 11 to 12, the resulting wIPD would be 7.52, i.e. only 0.09 more than the wIPD for C.

**5.1.4.2.** As a check, the IPDs and wIPDs for C + some other

languages of EC have been calculated. The results are:

| | *IPD* | *Increase over IPD for C* | *wIPD* | *Increase over wIPD for C* |
|---|---|---|---|---|
| C + Siane of 2b (Att.42) | 13 | 2 | 8.18 | 0.75 |
| C + Gahuku of 2c (Att.43) | 15 | 4 | 9.40 | 1.97 |
| C + Kanite of 2d (Att.44) | 16 | 5 | 10.01 | 2.68 |
| C + Fore of 2e (Att.45) | 13 | 2 | 8.18 | 0.75 |

**5.1.4.3.** These figures reveal that, of the languages of EC, Gende of 2a has not the closest phonological affinity to C, though it exhibits less phonological diversification from C than from EC. Siane and Fore have more phonological affinity to C than has Gende, but it is significant that the exclusion of Gende from EC causes the IPD of EC to drop by 5, and the wIPD by 3.07, whereas the exclusion of Siane or Fore from EC does not affect the IPD for EC which remains 14, with an increase in the wIPD by 0.84, because of the decrease in the number of languages. This demonstrates that Siane and Fore have much closer phonological affinity to EC than to C. At the same time, the figures based on comparisons involving Siane and Fore intimate that there is a higher degree of some sort of phonological affinity between these two languages than between them and the other two languages of EC used in the above table. The figures in the table given below suggest the same, as does the relatively low IPD for 2b-2e (see the tables in **3.1**) which breaks the tendency of the wIPDs in EC to increase steadily with growing geographical distance (see **3.2.2.1.**).

**5.1.4.4.** Another approach to the problem of Gende is to calculate the wIPDs for 3d + Gende, and + other languages of EC, as if Gende, or any of the other languages, belonged to 3a. 3d is the Sub-Family of C which is neighbouring on Gende, and with which Gende shares the highest number of typological features. The results are:

| | *IPD* | *Increase over IPD for 3d* | *wIPD* | *Increase over wIPD for 3d* |
|---|---|---|---|---|
| 3d + Gende (Att. 46) | 9 | 5 | 3.12 | 1.54 |
| 3d + Siane (Att. 47) | 6 | 2 | 2.07 | 0.49 |
| 3d + Gahuku (Att. 48) | 8 | 4 | 2.76 | 1.18 |
| 3d + Kanite (Att. 49) | 11 | 7 | 3.81 | 2.23 |
| 3d + Fore (Att. 50) | 7 | 3 | 2.43 | 0.95 |

**5.1.4.5.** These figures demonstrate that the phonological affinity of Gende is rather with C as a whole than with 3d in particular: its differences from the latter are greater relative to the differences displayed by other languages of EC to 3d than is the case with its differences from C.

**5.1.4.6.** The conclusion reached regarding Gende of 2a is that it is a phonologically aberrant language which has closer, though not very close, phonological affinities with C than with EC to which it belongs when judging by the majority of its typological features, and by the lexical evidence.

**5.1.5.0.** Having dealt with 2a, the influence of the moderately aberrant 2e within (EC), i.e. EC without 2a, merits study. When disregarding 2e in the calculations of the figures for (EC) (Att. 51) the resulting IPD of 7 (7 lower than the IPD for EC, and 2 lower than that for (EC)) yields a wIPD of 6.58 which is 3.54 lower than that for EC, and 0.47 lower than that for (EC). The reducing influence of the omission of the phonologically somewhat aberrant 2e upon the wIPD for (EC) is so great that it outweighs the augmenting influence of the drop in the number of languages by two. By way of contrast, disregarding 2b in the calculation of the figures for (EC) (Att. 52) produces an IPD of 8 (6 lower than the IPD for EC, and 1 lower than that for (EC)) yielding a wIPD of 7.52 which is only 2.60 lower than that for EC, and 0.47 *higher* than that for (EC). This clearly indicates and confirms the fact that, within (EC), 2e is phonologically more aberrant than 2b (see **3.2.1.** and **4.1.3.**).

**5.1.5.1.** To demonstrate this fact from a different angle, the following figures have been calculated: [(EC) without 2e] - E (Att. 53) which gives an IPD of 9 yielding a wIPD of 8.93, and [(EC) without 2b] - E (Att. 54) which produces an IPD of 10 yielding a wIPD of 9.87. The larger size of the second two figures is due to the more tenuous phonological homogeneity of 2c + 2d + 2e relative to that of 2b + 2c + 2d, which is a direct result of the phonologically somewhat aberrant nature of 2e.

**5.2.0.** C and related problems:

**5.2.1.** The wIPDs and average figures have demonstrated 3d to be phonologically somewhat aberrant, and the figures arrived at for 3a to be unexpectedly low. Figures calculated for C disregarding 3d (Att. 55) are: IPD 5 (6 lower than that for C) yielding a wIPD of 6.67 (0.76 lower than the wIPD for C).

These figures show that 3d is in fact somewhat aberrant phonologically and indicate the closer phonological coherence of the remaining three Sub-Families. The latter fact is proved by further figures calculated while disregarding one of the other Sub-Families instead of 3d: C without 3b (Att. 56), yields an IPD of 11 (same as for C) with a wIPD of 7.99 (0.56 *higher* than that for C and 1.32 higher than that for 3a-3b-3c); C without 3a (Att. 57), an IPD of 11 (same as for C) with a wIPD of 9.40 (1.97 higher than that for C and 2.73 higher than that for 3a-3b-3c). These figures reflect the more tenuous phonological coherence, relative to that of C and even much more to that of 3a-3b-3c, of the remaining three Sub-Families of C when 3b, or 3a, are disregarded. At the same time, they show that 3a-3c-3d are phonologically more homogeneous than 3b-3c-3d which discloses the greater significance of 3a relative to 3b, for the phonological coherence of three Sub-Families in C. This in turn serves as a further proof that 3a is, in contradistinction to other typological, and lexical, evidence, really very little at variance phonologically with the other Sub-Families of C, as has already been demonstrated by the wIPDs and average figures (see **3.2.1.**, **3.2.2.1.** and **4.1.4.**).

**5.3.0.** WC and related problems:

**5.3.1.** It has been mentioned (see **1.1.5.1.1.**) that the aberrant phonological character of the languages of 4a, and of Mendi, could be veiled by cluster solution, though the results would be unrealistic. To illustrate the effect of cluster solution upon the figures, they have been calculated for 4a (cluster sol.) - 4c (Att. 58): IPD 3 (10 lower than that for 4a - 4c) yielding a wIPD of 3.31 (12.15 lower than that for 4a-4c). As has been pointed out, however (see **1.1.5.1.1.**), this great reduction in the figures largely represents the replacement of one type of complexity by another one which does not manifest itself in the figures dealt with in this study.

**5.3.2.** The very high wIPDs for WC and for pairs of the Sub-Families in it are obviously attributable to the aberrant phonological character of 4a and of Mendi of 4d. The figures for WC without 4a (Att. 59) are: IPD 10 (7 below that of WC) yielding a wIPD of 13.44 (2.54 lower than that for WC), and for WC without 4a and Mendi of 4d [marked as (WC)] (Att.60): IPD 6 (11 lower than that for W) yielding a wIPD of 9.40 (6.58 below that for WC). The last figure compares well with the wIPDs for the other Families; it is in fact lower than that for EC, though it is still the highest of the four if EC is replaced by (EC), i.e. E 7.33, (EC) 7.05, C 7.43,

(WC) 9.40. If the wIPD for (WC) is calculated as a wIPD for a pair of Sub-Families (i.e. 4c + 4d without Mendi) instead of a wIPD for a Family, it is 5.52, which again fits in very well with the great majority of the wIPDs for pairs of the Sub-Families.

**5.3.3.** To complement the above discussion, the figures for 4a + Mendi of 4d have been calculated (Att. 61): IPD 9 yielding a wIPD of 6.21 if the languages involved are treated as if they belonged to the same Sub-Family, and of 12.42 if they are regarded as belonging to two. These figures are very high, the second one ranks with those arrived at for 2a + another Sub-Family of EC, and the first one exceeds the wIPD for 4d by 0.69 which suggests that Mendi, in spite of its aberrant phonology when compared with the other languages of 4d, still has a somewhat higher degree of phonological affinity to these languages than to those of 4a.

**5.3.4.** Calculating the figures for 4d without Mendi appears to be the next obvious step (Att. 62): IPD 5 (5 lower than that for 4d) yielding a wIPD of 3.45 (2.07 below that for 4d). This is still rather high when compared with the wIPDs for other Sub-Families within the Stock, and indicates that the languages of 4d are characterized by a higher degree of phonological diversity when compared with each other than is the case with the languages belonging to other Sub-Families in the Stock.

**5.3.5.0.** Calculating the figures for pairs of Families consisting of (WC) and one of the other Families gives the following results:

| | *IPD* | *Difference from IPD for WC - F* | *wIPD* | *Difference from wIPD for WC - F* |
|---|---|---|---|---|
| (WC) - E (Att. 63) | 11 | 10 less | 13.82 | 6.95 less |
| (WC) - EC (Att. 64) | 14 | 10 less | 13.82 | 5.80 less |
| (WC) - C (Att. 65) | 13 | 11 less | 12.22 | 6.58 less |
| (WC) - W (Att. 66) | 16 | 5 less | 42.96 | 7.05 more |

**5.3.5.1.** The major reason for obtaining these figures has been to establish if they indicate an improvement in the matter of the unsatisfactorily high wIPD for WC - EC relative to that for WC-C (see **3.2.2.0.**). However, this is not the case, and it appears that the augmenting influence of increased geographical distance upon wIPDs for pairs of Families overrides any tendency towards a reduction in the

wIPD for WC-EC or (WC) - EC which may perhaps be expected in the light of other typological findings. The extremely high wIPD for (WC)-W is understandable if it is taken into consideration that what little there is of phonological affinity between WC and W is largely confined to 4a and Mendi on the WC side, and both of these are excluded from (WC).

**5.3.5.2.** The calculation of the figures for (WC) - (EC) (Att. 67) shows even less favourable results than those for (WC) - EC: IPD 13 (11 below that for WC-EC, and 1 less than that for (WC) - EC), yielding a wIPD of 13.54 (6.08 lower than that for WC-EC) which is only 0.28 below that for (WC)-EC and still 1.32 higher than that for (WC)-C. (The difference between the wIPDs for (WC)-EC and (WC)-C is 1.60.) Far from bringing about a favourable change in the wIPD for WC-EC relative to that for WC-C, the replacement of WC by (WC), as well as of EC by (EC) in the calculations leads to a worsening of the picture, i.e. to an increase of the various wIPDs for WC-EC and its alternatives relative to those for WC-C and its alternatives (the difference between the basic WC-EC and WC-C is only 0.82). The one figure not given yet, i.e. that for WC-(EC) (see Att. 39) does not improve the picture at all: the IPD 24 (same as for WC-EC) yields a wIPD of 20.49 (0.87 *higher* than that for WC-EC).

**5.3.5.3.** The result of the calculations involving comparisons between WC and EC is that no figures can be arrived at which bear out the limited agreement observed between WC and EC on other typological levels. It appears that the influence of increased geographical distance upon the wIPDs for WC-EC and its alternatives outweighs the influence of typological agreements between WC and EC on other levels. It may also be pointed out that it is questionable if the typological agreements between WC and EC could be regarded as more pronounced or even equal to those existing between WC and C, or at least a large section of C, because those between WC and EC are largely in points of relatively minor importance (Wurm 1964).

**5.4.0.** W and related problems.

**5.4.1.0.** The very high wIPDs and average figures for pairs of Families consisting of W + another Family are understandable in the light of the very profound typological diversity existing between W and the other four Families (Wurm 1964). However, it is remarkable that the wIPD for W-WC is much higher than those for W-C and W-EC, and not very much lower than that for W-E, while W displays a higher level of typological agreement, limited as it may be, with WC than with

any of the other Families. If in the calculation of wIPDs for W + another Family, W is treated as if it belonged as an extra language to its partner in the comparison rather than constituting another, one-language Family, and the resulting wIPDs are compared with those for the original Families with which W is compared, the results cancel out this anomaly:

| | *wIPD for Family consisting of W + F* | *Difference from wIPD for the Family with which W is compared* |
|---|---|---|
| W + E | 18.80 | 11.47 |
| W + EC | 15.44 | 5.32 |
| W + C | 13.16 | 5.73 |
| W + WC | 17.95 | 1.97 |

**5.4.1.1.** These figures show quite clearly that W has much closer phonological affinity to WC than to the other three Families which parallels the findings on other typological levels.

**5.4.1.2.** If in the above calculations, WC is replaced by (WC), the resulting wIPD is 21.48, and the difference between this and the wIPD for (WC) is 12.08. This is clear evidence of the fact that the phonological affinity between W and WC as revealed by the difference between the wIPDs for W + WC (as one Family) and for WC hinges on 4a and Mendi on the WC side - they are both excluded from (WC).

**5.4.1.3.** The next step is obviously to calculate the figures for W + (4a and Mendi) as if they all constituted one Family (Att. 68): IPD 14 yielding a wIPD of 26.32 which is very high. If W + (4a and Mendi) are treated in the calculation of the wIPD as if they belonged to the same Sub-Family, the resulting wIPD is 7.73, and it is 15.46 if they are regarded as belonging to two Sub-Families which is the same as that for 4a-4c. The figures calculated for W + 4a, treating them as members of one or two Sub-Families (Att. 69) are lower; they are in fact identical with those for 4a + Mendi (see **5.3.3.**): IPD 9 yielding a wIPD of 6.21 if W and 4a are regarded as constituting one Sub-Family, and 12.42 if they are considered as belonging to two different ones. It is clear from these figures that W has its closest phonological affinities with 4a, and they also demonstrate that the phonological differences between W and 4a, W and (4a + Mendi), and consequently between W and WC as a whole, while still very considerable, do not exceed those prevailing between the Sub-Families in WC itself. As has been disclosed by the figures in **5.4.1.0.**, this difference is by far the

lowest of those existing between W and the other Families of the Stock. This whole picture shows a measure of parallelism with findings based on other typological evidence, and also with those obtained on the grounds of lexical evidence.

## 6. GENERAL RESULTS AND CONCLUSIONS

**6.0.** This study has demonstrated that the calculation of indices of phonological differentiation for Families, Sub-Families and other groups of languages within the East New Guinea Highlands Stock, and the treatment and evaluation of the indices according to a number of special principles, yields results which, with few exceptions, parallel and support findings arrived at on the grounds of observations involving other facets of language structure. To a lesser extent, they also parallel findings made on lexical grounds. This makes it possible to suggest that procedures like those discussed and applied here may constitute a useful tool in assessing and evaluating phonological similarities and differences between related languages on a broad level, and may be helpful in enlarging the basis on which a general comparison of related languages can be carried out.

**6.1.** Another result emerging from the discussions in this study is the recognition of a steadily augmenting influence of increasing geographical distance upon the rate of phonological diversification, especially on the family level. This phenomenon is very similar to one observable within groups of related languages in New Guinea on the lexical, and to a lesser extent on other typological, levels. On the lexical level, it manifests itself in dialect chains which greatly contribute to the difficulties of delineating related New Guinea communalects as separate languages (Wurm and Laycock 1961: 137), whereas on the typological level, a comparable tendency towards a gradual decrease in the number of features shared by languages and language groups can be observed in quite a few cases as running parallel with increasing geographical distance between the languages and language groups. It appears that amongst all the typological features this phenomenon is most clearly exhibited by the rates of phonological diversity as manifested in the indices of phonological diversification.

*APPENDIX*

## ATTESTATION: NON-EXISTENT MINIMAX SYSTEMS

**Att. 1:** **1a - 1b**

| MAXIMUM | | | | MINIMUM | | | |
|---|---|---|---|---|---|---|---|
| p | t | k | ʔ | p | t | k | ʔ |
| b | d | g | | b | | | |
| m | n | | | m | n | | |
| ʔm | ʔn | | | | | | |
| m: | n: | | | | | | |
| | s | | | | | | |
| | r | | | | | | |
| w | y | | | | y | | |
| ʔw | ʔy | | | | | | |

| MAXIMUM | | | MINIMUM | | |
|---|---|---|---|---|---|
| i | | u | i | | u |
| e | ə | o | e | | o |
| | a | | | a | |

| | | |
|---|---|---|
| Stops: | 4 max. to 4 min. | = 0 interval |
| Nasals: | 2 max. to 2 min. | = 0 interval |
| Fricatives: | 1 max. to 0 min. | = 1 interval |
| Liquids: | 1 max. to 0 min. | = 1 interval |
| Semi-vowels: | 2 max. to 1 min. | = 1 interval |
| Vowels: | 6 max. to 5 min. | = 1 interval |
| General interval | | 4 = IPD for 1a - 1b |

**Att. 2:** **1a - 1c**

| MAXIMUM | | | | MINIMUM | | | |
|---|---|---|---|---|---|---|---|
| p | t | k | ʔ | p | t | k | ʔ |
| b | d | g | | b | | | |
| m | n | | | m | n | | |
| | s | | | | | | |
| | r | | | | | | |
| w | y | | | | y | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| æ | a | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

Stops: 4 max. to 4 min. = 0 interval
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 1 max. to 0 min. = 1 interval
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 1 min. = 1 interval
Vowels: 7 max. to 6 min. = 1 interval
General interval 4 = IPD for 1a - 1c

**Att. 3:** **1a - 1d**

MAXIMUM

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | d | | |
| $^{n}$b | $^{n}$d | $^{n}$g | |
| m | n | | |
| | | h | |
| | r | | |
| | y | | |

MINIMUM

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | | | |
| m | n | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

Stops: 4 max. to 4 min. = 0 interval
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 1 max. to 0 min. = 1 interval
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 1 max. to 0 min. = 1 interval
Vowels: 6 max. to 6 min. = 0 interval
General interval 3 = IPD for 1a - 1d

**Att. 4:** **1b - 1c**

MAXIMUM

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | | g | |

MINIMUM

| | | | |
|---|---|---|---|
| p | t | k | ? |
| b | | g | |

| | |
|---|---|
| m | n |
| ʔm | ʔn |
| m: | n: |
| | s |
| | r |
| w | y |
| ʔw | ʔy |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
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| | |
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| m | n |
| | s |
| | r |
| w | y |

| | | |
|---|---|---|
| i | | u |
| e | | o |
| | a | |

Stops: 4 max. to 4 min. = 0 interval
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 1 max. to 1 min. = 0 interval
Liquids: 1 max. to 1 min. = 0 interval
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 7 max. to 5 min. = 2 intervals
General interval 2 = IPD for 1b - 1c

**Att. 5:** **1b - 1d**

MAXIMUM

| | | | |
|---|---|---|---|
| p | t | k | ʔ |
| b | | g | |
| ⁿb | ⁿd | ⁿg | |
| m | n | | |
| ʔm | ʔn | | |
| m: | n: | | |
| | | h | |
| | r | | |
| w | y | | |
| ʔw | ʔy | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | a | |

MINIMUM

| | | | |
|---|---|---|---|
| p | t | k | ʔ |
| b | | | |
| m | n | | |
| | | | |
| | r | | |

| | | |
|---|---|---|
| i | | u |
| e | | o |
| | a | |

| | | | |
|---|---|---|---|
| Stops: | 4 max. | to 4 min. | = 0 interval |
| Nasals: | 2 max. | to 2 min. | = 0 interval |
| Fricatives: | 1 max. | to 0 min. | = 1 interval |
| Liquids: | 1 max. | to 1 min. | = 0 interval |
| Semi-vowels: | 2 max. | to 0 min. | = 2 intervals |
| Vowels: | 6 max. | to 5 min. | = 1 interval |
| General interval | | | 4 = IPD for 1b - 1d |

**Att. 6:** **1c - 1d**

**MAXIMUM**

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|---|---|---|---|
| Stops: | 4 max. | to 4 min. | = 0 interval |
| Nasals: | 2 max. | to 2 min. | = 0 interval |
| Fricatives: | 2 max. | to 0 min. | = 2 intervals |
| Liquids: | 1 max. | to 1 min. | = 0 interval |
| Semi-vowels: | 2 max. | to 0 min. | = 2 intervals |
| Vowels: | 7 max. | to 6 min. | = 1 interval |
| General interval | | | 5 = IPD for 1c - 1d |

**Att. 7:** **2a - 2b**

**MAXIMUM**

| | | | | |
|---|---|---|---|---|
| p | t | t$^{y}$ | k | k$^{w}$ |
| b | d | d$^{y}$ | g | g$^{w}$ |
| $^{n}$b | $^{n}$d | $^{n}$d$^{y}$ | $^{n}$g | $^{n}$g$^{w}$ |
| m | n | n$^{y}$ | | |
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Stops: 5 max. to 3 min. = 2 intervals
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 2 max. to 0 min. = 2 intervals
Liquids: 2 max. to 1 min. = 1 interval
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 6 max. to 5 min. = 1 interval
General interval 7 = IPD for 2a - 2b

**Att. 8:** **2a - 2c**

MAXIMUM

p t $t^y$ k $k^w$ ?
b $d^y$ g $g^w$
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MINIMUM

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Stops: 6 max. to 3 min. = 3 intervals
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 2 max. to 1 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 6 max. to 5 min. = 1 interval
General interval 11 = IPD for 2a - 2c

**Att. 9:** **2a - 2d**

| MAXIMUM | | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|---|
| p | t | $t^y$ | λ | k | $k^w$ | ? | p | t | k |
| b | | $d^y$ | | g | $g^w$ | | b | | |
| $^nb$ | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^w$ | | | | |
| m | n | $n^y$ | | | | | m | n | |
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| Stops: | 7 max. to 3 min. | = 4 intervals |
| Nasals: | 3 max. to 2 min. | = 1 interval |
| Fricatives: | 3 max. to 0 min. | = 3 intervals |
| Liquids: | 2 max. to 0 min. | = 2 intervals |
| Semi-vowels: | 2 max. to 0 min. | = 2 intervals |
| Vowels: | 6 max. to 5 min. | = 1 interval |
| General interval | | 13 = IPD for 2a - 2d |

**Att. 10:** **2a - 2e**

| MAXIMUM | | | | | | MINIMUM | |
|---|---|---|---|---|---|---|---|
| p | t | $t^y$ | k | $k^w$ | ? | p | t |
| b | d | $d^y$ | g | $g^w$ | | | |
| $^nb$ | $^nd$ | $^nd^y$ | $^ng$ | $^ng^w$ | | | |
| m | n | $n^y$ | | | | m | n |
| | s | | | | | | |
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| Stops: | 6 max. | to 2 min. | = 4 intervals |
| Nasals: | 3 max. | to 2 min. | = 1 interval |
| Fricatives: | 1 max. | to 0 min. | = 1 interval |
| Liquids: | 2 max. | to 0 min. | = 2 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 6 max. | to 6 min. | = 0 interval |
| General interval | | | 8 = IPD for 2a - 2e |

**Att. 11:** **2b - 2c**

MAXIMUM

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MINIMUM

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| Stops: | 4 max. | to 3 min. | = 1 interval |
| Nasals: | 2 max. | to 2 min. | = 0 interval |
| Fricatives: | 3 max. | to 1 min. | = 2 intervals |
| Liquids: | 1 max. | to 1 min. | = 0 interval |
| Semi-vowels: | 2 max. | to 0 min. | = 2 intervals |
| Vowels: | 5 max. | to 5 min. | = 0 interval |
| General interval | | | 5 = IPD for 2b - 2c |

**Att. 12:** **2b - 2d**

MAXIMUM

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MINIMUM

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**Att. 14:** **2c - 2d**

**MAXIMUM**

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Stops: 5 max. to 4 min. = 1 interval
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 3 max. to 2 min. = 1 interval
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 6 max. to 5 min. = 1 interval
General interval 6 = IPD for 2c - 2d

**Att. 15:** **2c - 2e**

**MAXIMUM**

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Stops: 4 max. to 3 min. = 1 interval
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 3 max. to 1 min. = 2 intervals
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 6 max. to 5 min. = 1 interval
General interval 7 = IPD for 2c - 2e

**Att. 16:** **2d - 2e**

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Stops: 5 max. to 3 min. = 2 intervals
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 3 max. to 1 min. = 2 intervals
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 6 max. to 5 min. = 1 interval
General interval 8 = IPD for 2d - 2e

**Att. 17:** **3a - 3b**

MAXIMUM

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Stops: 5 max. to 4 min. = 1 interval
Nasals: 4 max. to 4 min. = 0 interval
Fricatives: 0 max. to 0 min. = 0 interval
Liquids: 2 max. to 2 min. = 0 interval
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 6 min. = 3 intervals
General interval 4 = IPD for 3a - 3b

**Att. 18:** **3a - 3c**

**MAXIMUM**

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**MINIMUM**

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Stops: 5 max. to 4 min. = 1 interval
Nasals: 4 max. to 4 min. = 0 interval
Fricatives: 1 max. to 0 min. = 1 interval
Liquids: 2 max. to 2 min. = 0 interval
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 8 min. = 1 interval
General interval 3 = IPD for 3a - 3c

**Att. 19:** **3a - 3d**

**MAXIMUM**

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**MINIMUM**

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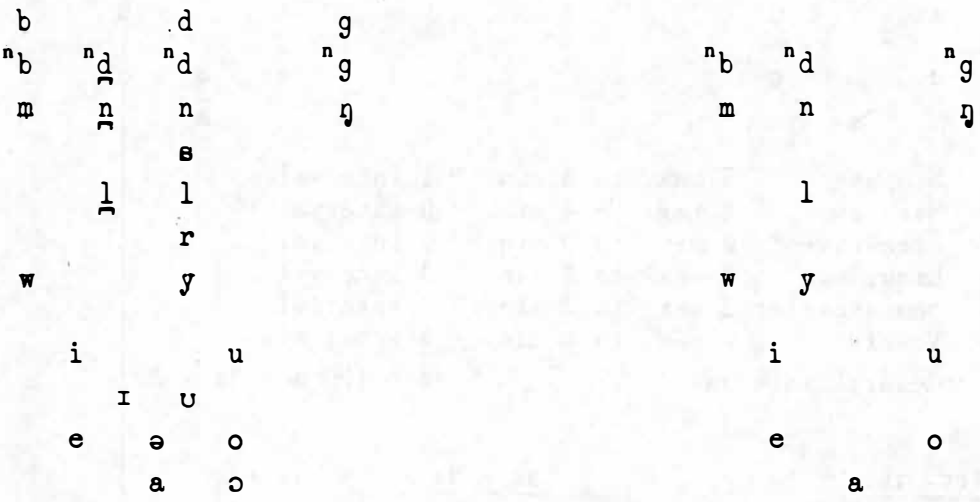


Stops: 5 max. to 4 min. = 1 interval
Nasals: 4 max. to 3 min. = 1 interval
Fricatives: 1 max. to 0 min. = 1 interval
Liquids: 3 max. to 1 min. = 2 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 5 min. = 4 intervals
General interval 9 = IPD for 3a - 3d

**Att. 20:** **3b - 3c**

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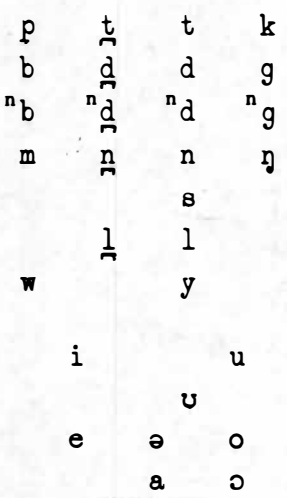
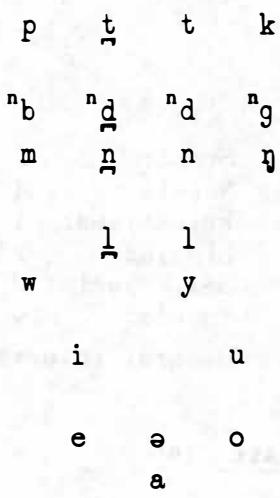



MINIMUM



| | | | |
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| Stops: | 4 max. | to 4 min. | = 0 interval |
| Nasals: | 4 max. | to 4 min. | = 0 interval |
| Fricatives: | 1 max. | to 0 min. | = 1 interval |
| Liquids: | 2 max. | to 2 min. | = 0 interval |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 8 max. | to 6 min. | = 2 intervals |
| General interval | | | 3 = IPD for 3b - 3c |

**Att. 21:** **3b - 3d**

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| Stops: | 5 max. | to 3 min. | = 2 intervals |
| Nasals: | 4 max. | to 2 min. | = 2 intervals |
| Fricatives: | 1 max. | to 0 min. | = 1 interval |
| Liquids: | 3 max. | to 1 min. | = 2 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 8 max. | to 5 min. | = 3 intervals |
| General interval | | | 10 = IPD for 3b - 3d |

**Att. 22:** **3c - 3d**

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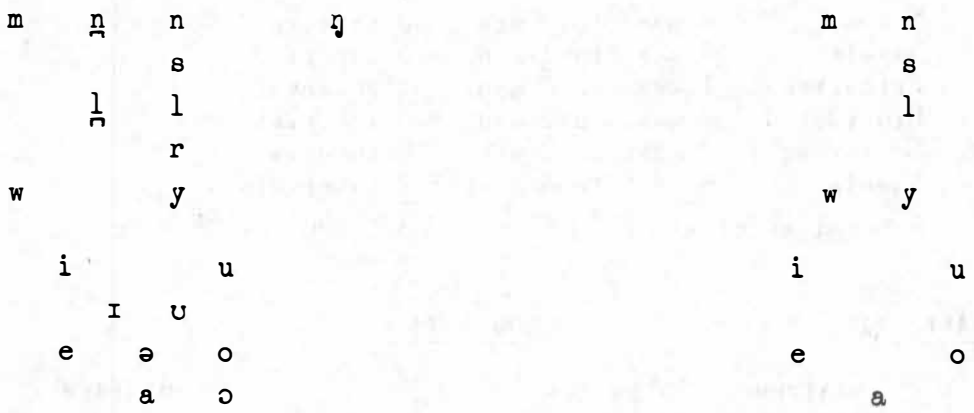


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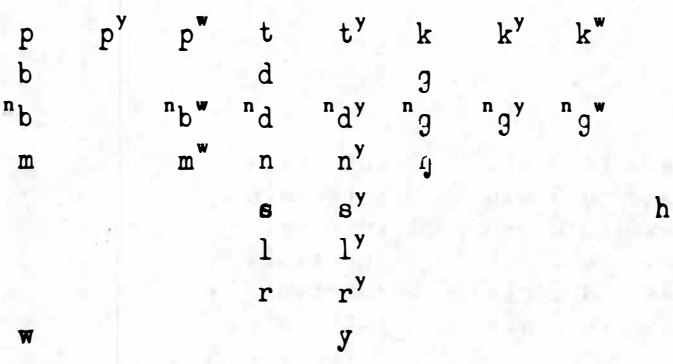
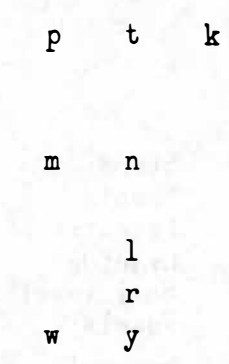
| Stops: | 5 max. to 3 min. | = 2 intervals |
| Nasals: | 4 max. to 2 min. | = 2 intervals |
| Fricatives: | 1 max. to 1 min. | = 0 interval |
| Liquids: | 3 max. to 1 min. | = 2 intervals |
| Semi-vowels: | 2 max. to 2 min. | = 0 interval |
| Vowels: | 9 max. to 5 min. | = 4 intervals |
| General interval | | 10 = IPD for 3c - 3d |

**Att. 23:** **4a - 4c**

MAXIMUM




MINIMUM



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| Stops: | 8 max. | to 3 min. | = 5 intervals |
| Nasals: | 5 max. | to 2 min. | = 3 intervals |
| Fricatives: | 3 max. | to 0 min. | = 3 intervals |
| Liquids: | 4 max. | to 2 min. | = 2 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 6 max. | to 5 min. | = 1 interval |
| General interval | | | 14 = IPD for 4a - 4c |

**Att. 24:** **4a - 4d**

MAXIMUM

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| Stops: | 8 max. | to 3 min. | = 5 intervals |
| Nasals: | 5 max. | to 3 min. | = 2 intervals |
| Fricatives: | 3 max. | to 0 min. | = 3 intervals |
| Liquids: | 4 max. | to 1 min. | = 3 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 8 max. | to 5 min. | = 3 intervals |
| General interval | | | 16 = IPD for 4a - 4d |

**Att. 25:** **4c - 4d**

| MAXIMUM | | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|---|
| p | $p^w$ | t | $t^y$ | k | $k^w$ | | p | t | k |
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| Stops: | 6 max. | to 3 min. | = 3 intervals |
| Nasals: | 3 max. | to 2 min. | = 1 interval |
| Fricatives: | 2 max. | to 0 min. | = 2 intervals |
| Liquids: | 3 max. | to 1 min. | = 2 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 7 max. | to 5 min. | = 2 intervals |
| General interval | | | 10 = IPD for 4c - 4d |

**Att. 26:** **E - EC**

| MAXIMUM | | | | | | | MINIMUM | |
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| p | t | $t^y$ | λ | k | $k^w$ | ʔ | p | t |
| b | d | $d^y$ | | g | $g^w$ | | | |
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Stops: 7 max. to 2 min. = 5 intervals
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 2 max. to 0 min. = 2 intervals
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 7 max. to 5 min. = 2 intervals
General interval 15 = IPD for E - EC

**Att. 27:** **E - C**

| MAXIMUM | | | | | | MINIMUM | | |
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|---|---|---|---|
| Stops: | 6 max. | to 3 min. | = 3 intervals |
| Nasals: | 4 max. | to 2 min. | = 2 intervals |
| Fricatives: | 2 max. | to 0 min. | = 2 intervals |
| Liquids: | 3 max. | to 0 min. | = 3 intervals |
| Semi-vowels: | 2 max. | to 0 min. | = 2 intervals |
| Vowels: | 10 max. | to 5 min. | = 5 intervals |
| General interval | | | 17 = IPD for E - C |

**Att. 28:** **E - WC**

| MAXIMUM | | | | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^y$ | $p^w$ | t | $t^y$ | k | $k^y$ | $k^w$ | ? | p | t | k |
| b | | | d | | g | | | | | | |
| $^nb$ | | $^nb^w$ | $^nd$ | $^nd^y$ | $^ng$ | $^ng^y$ | $^ng^w$ | | | | |
| m | | $m^w$ | n | $n^y$ | ŋ | | | | m | n | |
| $^?m$ | | | $^?n$ | | | | | | | | |
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| w | | | | y | | | | | | | |
| $^?w$ | | | | $^?y$ | | | | | | | |

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| Stops: | 9 max. | to 3 min. | = 6 intervals |
| Nasals: | 5 max. | to 2 min. | = 3 intervals |
| Fricatives: | 3 max. | to 0 min. | = 3 intervals |
| Liquids: | 4 max. | to 0 min. | = 4 intervals |
| Semi-vowels: | 2 max. | to 0 min. | = 2 intervals |
| Vowels: | 8 max. | to 5 min. | = 3 intervals |
| General interval | | | 21 = IPD for E - WC |

**Att. 29:** **E - W**

| MAXIMUM | | | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^w$ | t̂ | t | $t^y$ | | k | $k^w$ | ? | p | t | k |
| b | $b^w$ | | d | $d^y$ | | g | $g^w$ | | b | | |
| $^nb$ | | | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^w$ | | | | |
| m | | | n | $n^y$ | $n^w$ | ŋ | | | m | n | |
| $^?m$ | | | $^?n$ | | | | | | | | |
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| $^?w$ | | | | $^?y$ | | | | | | | |

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Stops: 8 max. to 3 min. = 5 intervals
Nasals: 5 max. to 2 min. = 3 intervals
Fricatives: 2 max. to 0 min. = 2 intervals
Liquids: 4 max. to 0 min. = 4 intervals
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 9 max. to 5 min. = 4 intervals
General interval 20 = IPD for E - W

**Att. 30:** **EC - C**

| MAXIMUM | | | | | | | | MINIMUM | |
|---|---|---|---|---|---|---|---|---|---|
| p | t̪ | t | $t^y$ | λ | k | $k^w$ | ? | p | t |
| b | d̪ | d | $d^y$ | | g | $g^w$ | | | |
| $^nb$ | $^nd̪$ | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^w$ | | | |
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**Att. 32:** **EC - W**

| MAXIMUM | | | | | | | | | | MINIMUM | |
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| p | $p^w$ | t̂ | t | $t^y$ | | λ | k | $k^w$ | ʔ | p | t |
| b | $b^w$ | | d | $d^y$ | | | g | $g^w$ | | | |
| $^nb$ | | | $^nd$ | $^nd^y$ | | | $^ng$ | $^ng^w$ | | | |
| m | | | n | $n^y$ | $n^w$ | | ŋ | | | m | n |
| f | | | s | | | | | | h | | |
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| | | | l | $l^y$ | $l^w$ | | | | | | |
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| MAXIMUM | | | MINIMUM | |
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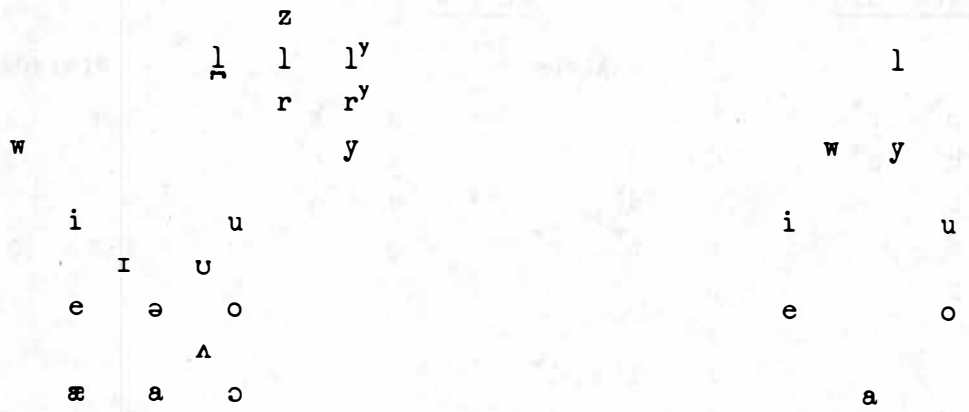
| Stops: | 9 max. to 2 min. | = 7 | intervals |
| Nasals: | 5 max. to 2 min. | = 3 | intervals |
| Fricatives: | 3 max. to 0 min. | = 3 | intervals |
| Liquids: | 4 max. to 0 min. | = 4 | intervals |
| Semi-vowels: | 2 max. to 0 min. | = 2 | intervals |
| Vowels: | 9 max. to 5 min. | = 4 | intervals |
| General interval | | 23 | = IPD for EC - W |

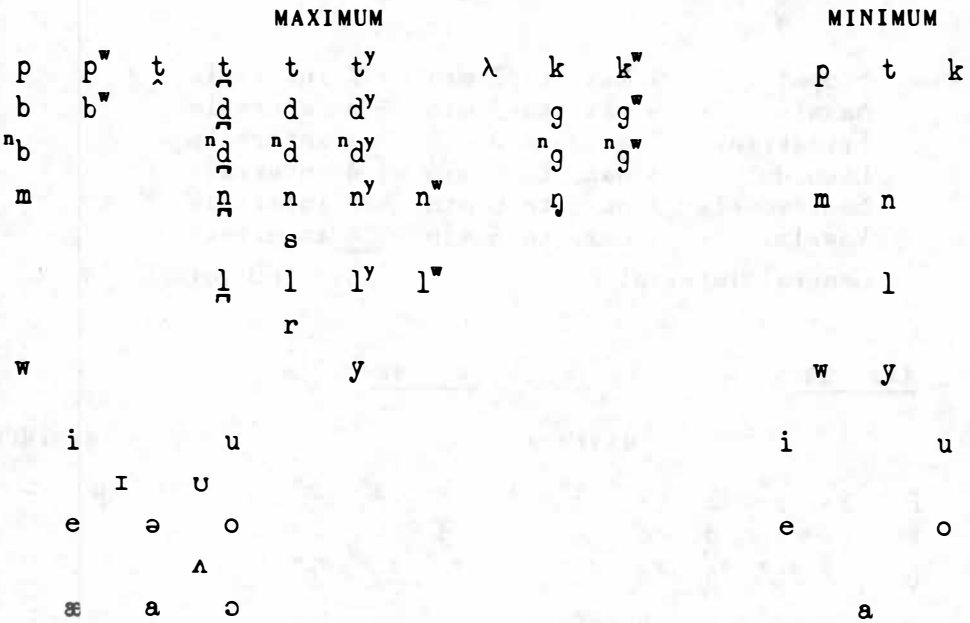
**Att. 33:** **C - WC**

| MAXIMUM | | | | | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^y$ | $p^w$ | t̪ | t | $t^y$ | λ | k | $k^y$ | $k^w$ | p | t | k |
| b | | | d̪ | d | | | g | | | | | |
| $^nb$ | | $^nb^w$ | $^nd̪$ | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^y$ | $^ng^w$ | | | |
| m | | $m^w$ | n̪ | n | $n^y$ | | ŋ | | | m | n | |
| | | | | s | $s^y$ | | | | h | | | |




Stops: 10 max. to 3 min. = 7 intervals
Nasals: 6 max. to 2 min. = 4 intervals
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 5 max. to 1 min. = 4 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 11 max. to 5 min. = 6 intervals
General interval 24 = IPD for C - WC

**Att. 34:** **C - W**



| | | | |
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| Stops: | 9 max. | to 3 min. | = 6 intervals |
| Nasals: | 6 max. | to 2 min. | = 4 intervals |
| Fricatives: | 1 max. | to 0 min. | = 1 interval |
| Liquids: | 5 max. | to 1 min. | = 4 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 11 max. | to 5 min. | = 6 intervals |
| General interval | | | 21 = IPD for C - W |

**Att. 35:** **WC - W**

| | MAXIMUM | | | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^y$ | $p^w$ | t̂ | t | $t^y$ | | k | $k^y$ | $k^w$ | | p | t | k |
| b | | $b^w$ | | d | $d^y$ | | g | | $g^w$ | | | | |
| $^nb$ | | $^nb^w$ | | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^y$ | $^ng^w$ | | | | |
| m | | $m^w$ | | n | $n^y$ | $n^w$ | ŋ | | | | m | n | |
| | | | | s | $s^y$ | | | | | h | | | |
| | | | | l | $l^y$ | $l^w$ | | | | | | l | |
| | | | | r | $r^y$ | | | | | | | | |
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| Stops: | 9 max. | to 3 min. | = 6 intervals |
| Nasals: | 6 max. | to 2 min. | = 4 intervals |
| Fricatives: | 3 max. | to 0 min. | = 3 intervals |
| Liquids: | 5 max. | to 1 min. | = 4 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 9 max. | to 5 min. | = 4 intervals |
| General interval | | | 21 = IPD for WC - W |

**Att. 36: EC without 2a [marked (EC) in the text]**

| MAXIMUM | | | | | MINIMUM | |
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| Stops: | 5 max. | to 2 min. | = 3 | intervals |
| Nasals: | 2 max. | to 2 min. | = 0 | interval |
| Fricatives: | 3 max. | to 1 min. | = 2 | intervals |
| Liquids: | 1 max. | to 0 min. | = 1 | interval |
| Semi-vowels: | 2 max. | to 0 min. | = 2 | intervals |
| Vowels: | 6 max. | to 5 min. | = 1 | interval |

General interval 9 = IPD for EC without 2a; i.e. for (EC)

**Att. 37: E - (EC without 2a); i.e. E - (EC)**

| MAXIMUM | | | | | MINIMUM | |
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Stops: 5 max. to 2 min. = 3 intervals
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 7 max. to 5 min. = 2 intervals
General interval 11 = IPD for E - (EC without 2a); i.e. for E - (EC)

**Att. 38: C - (EC without 2a); i.e. C - (EC)**

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Stops: 6 max. to 2 min. = 4 intervals
Nasals: 4 max. to 2 min. = 2 intervals
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 3 max. to 0 min. = 3 intervals
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 9 max. to 5 min. = 4 intervals
General interval 18 = IPD for C - (EC without 2a); i.e. for C - (EC)

**Att. 39:** **(EC) - WC**

| MAXIMUM | | | | | | | | | | MINIMUM | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^y$ | $p^w$ | t | $t^y$ | λ | k | $k^y$ | $k^w$ | ʔ | p | t |
| b | | | d | $d^y$ | | g | | $g^w$ | | | |
| $^nb$ | | $^nb^w$ | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^y$ | $^ng^w$ | | | |
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| f | | | s | $s^y$ | | | | | h | | |
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| | | | l | $l^y$ | | | | | | | |
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Stops: 10 max. to 2 min. = 8 intervals
Nasals: 5 max. to 2 min. = 3 intervals
Fricatives: 4 max. to 0 min. = 4 intervals
Liquids: 4 max. to 0 min. = 4 intervals
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 8 max. to 5 min. = 3 intervals
General interval 24 = IPD for (EC) - WC

**Att. 40:** **(EC) - W**

| MAXIMUM | | | | | | | | | | MINIMUM | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^w$ | t̂ | t | $t^y$ | | λ | k | $k^w$ | ʔ | p | t |
| b | $b^w$ | | d | $d^y$ | | | g | $g^w$ | | | |
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| Stops: | 9 max. to 2 min. = 7 intervals |
| Nasals: | 5 max. to 2 min. = 3 intervals |
| Fricatives: | 3 max. to 1 min. = 2 intervals |
| Liquids: | 4 max. to 0 min. = 4 intervals |
| Semi-vowels: | 2 max. to 0 min. = 4 intervals |
| Vowels: | 9 max. to 5 min. = 4 intervals |
| General interval | 22 = IPD for (EC) - W |

**Att. 41:** **C + 2a**

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| Stops: | 7 max. | to 3 min. | = 4 intervals |
| Nasals: | 5 max. | to 2 min. | = 3 intervals |
| Fricatives: | 1 max. | to 0 min. | = 1 interval |
| Liquids: | 3 max. | to 1 min. | = 2 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 9 max. | to 5 min. | = 4 intervals |
| General interval | | | 14 = IPD for C + 2a |

**Att. 42:** **C + Siane of 2b**

**MAXIMUM**

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| Stops: | 5 max. | to 3 min. | = 2 intervals |
| Nasals: | 4 max. | to 2 min. | = 2 intervals |
| Fricatives: | 2 max. | to 0 min. | = 2 intervals |
| Liquids: | 3 max. | to 0 min. | = 3 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 9 max. | to 5 min. | = 4 intervals |
| General interval | | | 13 = IPD for C + Siane of 2b |

**Att. 43:** **C + Gahuku of 2c**

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| Stops: | 6 max. to 3 min. | = 3 intervals |
| Nasals: | 4 max. to 2 min. | = 2 intervals |
| Fricatives: | 2 max. to 0 min. | = 2 intervals |
| Liquids: | 3 max. to 0 min. | = 3 intervals |
| Semi-vowels: | 2 max. to 1 min. | = 1 interval |
| Vowels: | 9 max. to 5 min. | = 4 intervals |
| General interval | | 15 = IPD for C + Gahuku of 2c |

**Att. 44:** **C + Kanite of 2d**

| MAXIMUM | | | | | | MINIMUM | | |
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| Stops: | 6 max. | to 3 min. | = 3 intervals |
| Nasals: | 4 max. | to 2 min. | = 2 intervals |
| Fricatives: | 3 max. | to 0 min. | = 3 intervals |
| Liquids: | 3 max. | to 0 min. | = 3 intervals |
| Semi-vowels: | 2 max. | to 1 min. | = 1 interval |
| Vowels: | 9 max. | to 5 min. | = 4 intervals |
| General interval | | | 16 = IPD for C + Kanite of 2d |

**Att. 45:** **C + Fore of 2e**

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| Stops: | 6 max. | to 3 min. | = 3 intervals |
| Nasals: | 4 max. | to 2 min. | = 2 intervals |
| Fricatives: | 1 max. | to 0 min. | = 1 interval |
| Liquids: | 3 max. | to 0 min. | = 3 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 9 max. | to 5 min. | = 4 intervals |
| General interval | | | 13 = IPD for C + Fore of 2e |

**Att. 46:** **3d + Gende**

MAXIMUM

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| b | d | $d^y$ | | ɡ | $ɡ^w$ |
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| Stops: | 4 max. | to | 3 min. | = 1 interval |
| Nasals: | 3 max. | to | 2 min. | = 1 interval |
| Fricatives: | 2 max. | to | 1 min. | = 1 interval |
| Liquids: | 2 max. | to | 1 min. | = 1 interval |
| Semi-vowels: | 2 max. | to | 2 min. | = 0 interval |
| Vowels: | 7 max. | to | 5 min. | = 2 intervals |
| General interval | | | | 6 = IPD for 3d + Siane |

**Att. 48:** **3d + Gahuku**

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| Stops: | 5 max. | to | 3 min. | = 2 intervals |
| Nasals: | 3 max. | to | 2 min. | = 1 interval |
| Fricatives: | 2 max. | to | 1 min. | = 1 interval |
| Liquids: | 2 max. | to | 1 min. | = 1 interval |
| Semi-vowels: | 2 max. | to | 1 min. | = 1 interval |
| Vowels: | 7 max. | to | 5 min. | = 2 intervals |
| General interval | | | | 8 = IPD for 3d + Gahuku |

**Att. 49:** **3d + Kanite**

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Stops: 5 max. to 3 min. = 2 intervals
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 3 max. to 1 min. = 2 intervals
Liquids: 2 max. to 0 min. = 2 intervals
Semi-vowels: 2 max. to 1 min. = 1 interval
Vowels: 8 max. to 5 min. = 3 intervals
General interval 11 = IPD for 3d + Kanite

**Att. 50:** **3d + Fore**

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| Stops: | 5 max. | to 3 min. | = 2 intervals |
| Nasals: | 3 max. | to 2 min. | = 1 interval |
| Fricatives: | 1 max. | to 1 min. | = 0 interval |
| Liquids: | 2 max. | to 0 min. | = 2 intervals |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 7 max. | to 5 min. | = 2 intervals |
| General interval | | | 7 = IPD for 3d + Fore |

**Att. 51:** **(EC) without 2e**

| MAXIMUM | | | | MINIMUM | | |
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| Stops: | 4 max. | to 3 min. | = 1 interval |
| Nasals: | 2 max. | to 2 min. | = 0 interval |
| Fricatives: | 3 max. | to 1 min. | = 2 intervals |
| Liquids: | 1 max. | to 0 min. | = 1 interval |
| Semi-vowels: | 2 max. | to 0 min. | = 2 intervals |
| Vowels: | 6 max. | to 5 min. | = 1 interval |
| General interval | | | 7 = IPD for (EC) without 2e |

**Att. 52:** **(EC) without 2b**

| MAXIMUM | | | | | MINIMUM | | |
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Stops: 5 max. to 3 min. = 2 intervals
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 3 max. to 1 min. = 2 intervals
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 6 max. to 5 min. = 1 interval
General interval 8 = IPD for (EC) without 2b

**Att. 53:** [(EC) without 2e] - E

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Stops: 4 max. to 3 min. = 1 interval
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 7 max. to 5 min. = 2 intervals
General interval 9 = IPD for [(EC) without 2e] - E

**Att. 54:** **[(EC) without 2b] - E**

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Stops: 5 max. to 3 min. = 2 intervals
Nasals: 2 max. to 2 min. = 0 interval
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 1 max. to 0 min. = 1 interval
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 7 max. to 5 min. = 2 intervals
General interval 10 = IPD for [(EC) without 2b] - E

**Att. 55:** **C without 3d**

**MAXIMUM**

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Stops: 5 max. to 4 min. = 1 interval
Nasals: 4 max. to 4 min. = 0 interval
Fricatives: 1 max. to 0 min. = 1 interval
Liquids: 2 max. to 2 min. = 0 interval
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 6 min. = 3 intervals
General interval 5 = IPD for C without 3d

**Att. 56:** **C without 3b**

**MAXIMUM**

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Stops: 5 max. to 3 min. = 2 intervals
Nasals: 4 max. to 2 min. = 2 intervals
Fricatives: 1 max. to 0 min. = 1 interval
Liquids: 3 max. to 1 min. = 2 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 5 min. = 4 intervals
General interval 11 = IPD for C without 3b

**Att. 57:** **C without 3a**

MAXIMUM

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Stops: 5 max. to 3 min. = 2 intervals
Nasals: 4 max. to 2 min. = 2 intervals
Fricatives: 1 max. to 0 min. = 1 interval
Liquids: 3 max. to 1 min. = 2 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 5 min. = 4 intervals
General interval 11 = IPD for C without 3a

**Att. 58:** **4a (cluster solution) - 4c**

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Stops: 3 max. to 3 min. = 0 interval
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 2 max. to 0 min. = 2 intervals
Liquids: 2 max. to 2 min. = 0 interval
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 5 max. to 5 min. = 0 interval
General interval 3 = IPD for 4a (cluster solution) - 4c

**Att. 59:** **WC without 4a**

| MAXIMUM | | | | | | MINIMUM | | |
|---|---|---|---|---|---|---|---|---|
| p | $p^w$ | t | $t^y$ | k | $k^w$ | p | t | k |
| b | | d | | g | | | | |
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| m | | n | $n^y$ | | | m | n | |
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Stops: 6 max. to 3 min. = 3 intervals
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 2 max. to 0 min. = 2 intervals
Liquids: 3 max. to 1 min. = 2 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 7 max. to 5 min. = 2 intervals
General interval 10 = IPD for WC without 4a

**Att. 60:** **WC without 4a and Mendi of 4d**
**[marked (WC) in the text]**

| MAXIMUM | | | | | MINIMUM | | |
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| Stops: | 4 max. | to 3 min. | = 1 interval |
| Nasals: | 3 max. | to 2 min. | = 1 interval |
| Fricatives: | 2 max. | to 0 min. | = 2 intervals |
| Liquids: | 2 max. | to 1 min. | = 1 interval |
| Semi-vowels: | 2 max. | to 2 min. | = 0 interval |
| Vowels: | 6 max. | to 5 min. | = 1 interval |
| General interval | | | 6 = IPD for WC without 4a and Mendi of 4d; i.e. for (WC) |

**Att. 61:** **4a + Mendi of 4d**

| MAXIMUM | | | | | | | | MINIMUM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p | $p^y$ | $p^w$ | t | $t^y$ | k | $k^y$ | $k^w$ | p | $p^w$ | t | k | $k^w$ |
| $^nb$ | | $^nb^w$ | $^nd$ | $^nd^y$ | $^nʤ$ | $^nʤ^y$ | $^nʤ^w$ | $^nb$ | | $^nd$ | $^nʤ$ | |
| m | | $m^w$ | n | $n^y$ | ɲ | | | m | $m^w$ | n | $n^y$ | |
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Stops: 8 max. to 5 min. = 3 intervals
Nasals: 5 max. to 4 min. = 1 interval
Fricatives: 2 max. to 1 min. = 1 interval
Liquids: 4 max. to 3 min. = 1 interval
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 8 max. to 5 min. = 3 intervals
General interval 9 = IPD for 4a + Mendi of 4d

**Att. 62:** **4d without Mendi**

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| Stops: | 4 max. to 3 min. | = 1 interval |
| Nasals: | 3 max. to 3 min. | = 0 interval |
| Fricatives: | 2 max. to 0 min. | = 2 intervals |
| Liquids: | 2 max. to 1 min. | = 1 interval |
| Semi-vowels: | 2 max. to 2 min. | = 0 interval |
| Vowels: | 6 max. to 5 min. | = 1 interval |
| General interval | | 5 = IPD for 4d without Mendi |

**Att. 63:** **(WC) - E**

| MAXIMUM | | | | | MINIMUM | | |
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| p | t | $t^y$ | k | ʔ | p | t | k |
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| m | n | $n^y$ | | | m | n | |
| $^ʔm$ | $^ʔn$ | | | | | | |
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| Stops: | 5 max. to 3 min. | = 2 intervals |
| Nasals: | 3 max. to 2 min. | = 1 interval |
| Fricatives: | 2 max. to 0 min. | = 2 intervals |
| Liquids: | 2 max. to 0 min. | = 2 intervals |
| Semi-vowels: | 2 max. to 0 min. | = 2 intervals |
| Vowels: | 7 max. to 5 min. | = 2 intervals |
| General interval | | 11 = IPD for (WC) - E |

**Att. 64:** (WC) - EC

| MAXIMUM | | | | | | | MINIMUM | |
|---|---|---|---|---|---|---|---|---|
| p | t | $t^y$ | λ | k | $k^w$ | ʔ | p | t |
| b | d | $d^y$ | | g | $g^w$ | | | |
| $^nb$ | $^nd$ | $^nd^y$ | | $^ng$ | $^ng^w$ | | | |
| m | n | $n^y$ | | | | | m | n |
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Stops: 7 max. to 2 min. = 5 intervals
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 2 max. to 0 min. = 2 intervals
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 6 max. to 5 min. = 1 interval
General interval 14 = IPD for (WC) - EC

**Att. 65:** (WC) - C

| MAXIMUM | | | | | | | MINIMUM | | |
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| p | t̪ | t | $t^y$ | λ | k | | p | t | k |
| b | d̪ | d | | | g | | | | |
| $^nb$ | $^nd̪$ | $^nd$ | | | $^ng$ | | | | |
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Stops: 6 max. to 3 min. = 3 intervals
Nasals: 4 max. to 2 min. = 2 intervals
Fricatives: 2 max. to 0 min. = 2 intervals
Liquids: 3 max. to 1 min. = 2 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 5 min. = 4 intervals
General interval 13 = IPD for (WC) - C

**Att. 66:** **(WC) - W**

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Stops: 7 max. to 3 min. = 4 intervals
Nasals: 5 max. to 2 min. = 3 intervals
Fricatives: 2 max. to 0 min. = 2 intervals
Liquids: 4 max. to 1 min. = 3 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 5 min. = 4 intervals
General interval 16 = IPD for (WC) - W

**Att. 67:** **(WC) - (EC)**

| MAXIMUM | | | | | | MINIMUM | |
|---|---|---|---|---|---|---|---|
| p | t | $t^y$ | λ | k | ʔ | p | t |
| b | d | | | g | | | |
| $^nb$ | $^nd$ | | | $^ng$ | | | |
| m | n | $n^y$ | | | | m | n |
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Stops: 6 max. to 2 min. = 4 intervals
Nasals: 3 max. to 2 min. = 1 interval
Fricatives: 3 max. to 0 min. = 3 intervals
Liquids: 2 max. to 0 min. = 2 intervals
Semi-vowels: 2 max. to 0 min. = 2 intervals
Vowels: 6 max. to 5 min. = 1 interval
General interval 13 = IPD for (WC) - (EC)

**Att. 68:** **W + (4a and Mendi)**

MAXIMUM

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| p | p | $p^w$ | t̂ | t | $t^y$ | | k | $k^y$ | $k^w$ |
| b | | $b^w$ | | | $d^y$ | | ɡ | | $g^w$ |
| $^n$b | | $^nb^w$ | | $^n$d | $^nd^y$ | | $^n$ɡ | | $^ng^w$ |
| m | | $m^w$ | | n | $n^y$ | $n^w$ | ŋ | | |
| | | | | s | $s^y$ | | | | |
| | | | | l | $l^y$ | $l^w$ | | | |
| | | | | r | $r^y$ | | | | |
| w | | | | | y | | | | |

MINIMUM

| | | | | | |
|---|---|---|---|---|---|
| p | $p^w$ | t | | k | $k^w$ |
| $^n$b | | $^n$d | | $^n$ɡ | |
| m | | n | $n^y$ | | |
| | | s | | | |
| | | l | $l^y$ | | |
| | | r | | | |
| w | | | y | | |

| | | |
|---|---|---|
| i | | u |
| e | ə | o |
| | ʌ | |
| æ | a | ɔ |

| | | |
|---|---|---|
| i | | u |
| e | | o |
| | a | |

| | | |
|---|---|---|
| ɪ | | ʊ |
| | | ɒ |
| | ɐ | |

Stops: 9 max. to 5 min. = 4 intervals
Nasals: 6 max. to 3 min. = 3 intervals
Fricatives: 2 max. to 1 min. = 1 interval
Liquids: 5 max. to 3 min. = 2 intervals
Semi-vowels: 2 max. to 2 min. = 0 interval
Vowels: 9 max. to 5 min. = 4 intervals
General interval 14 = IPD for W + (4a and Mendi)

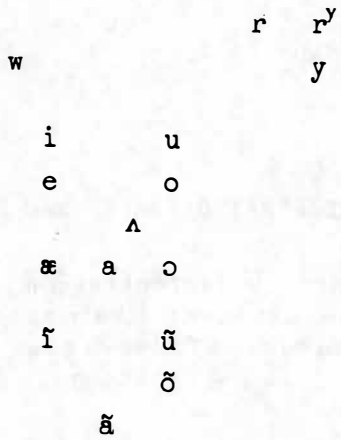
**Att. 69:** **W + 4a**

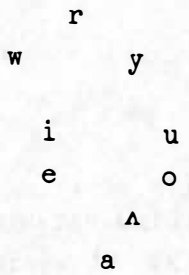
MAXIMUM

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| p | $p^y$ | $p^w$ | t̂ | t | $t^y$ | | k | $k^y$ | $k^w$ |
| b | | $b^w$ | | | $d^y$ | | ɡ | | $g^w$ |
| $^n$b | | $^nb^w$ | | $^n$d | $^nd^y$ | | $^n$ɡ | $^ng^y$ | $^ng^w$ |
| m | | | | n | $n^y$ | $n^w$ | ŋ | | |
| | | | | s | $s^y$ | | | | |
| | | | | l | $l^y$ | $l^w$ | | | |

MINIMUM

| | | | | | |
|---|---|---|---|---|---|
| p | $p^w$ | t | $t^y$ | k | $k^w$ |
| $^n$b | | $^n$d | $^nd^y$ | $^n$ɡ | $^ng^w$ |
| m | | n | $n^y$ | ŋ | |
| | | s | | | |
| | | l | $l^y$ | | |




| | | |
|---|---|---|
| Stops: | 9 max. to 6 min. | = 3 intervals |
| Nasals: | 5 max. to 4 min. | = 1 interval |
| Fricatives: | 2 max. to 1 min. | = 1 interval |
| Liquids: | 5 max. to 3 min. | = 2 intervals |
| Semi-vowels: | 2 max. to 2 min. | = 0 interval |
| Vowels: | 8 max. to 6 min. | = 2 intervals |
| General interval | | 9 = IPD for W + 4a |

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